THE

# AMERICAN NATURALIST,

AN ILLUSTRATED MAGAZINE

OF

# NATURAL HISTORY.

EDITED BY

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VOLUME VIII.

SALEM, MASS.

PEABODY ACADEMY OF SCIENCE.

1874. CLR

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# CONTENTS OF VOL. VIII.


NOTES FROM THE JOURNAL OF A BOTANIST IN EUROPE. By W. G. Farlow, M.D. pp. 1, 112, 295.

ORNITHOLOGICAL NOTES FROM THE SOUTH. By C.Hart Merriam. pp. 6, 85.

BOTANICAL OBSERVATIONS IN WESTERN WYOMING. By Dr. C. C. Parry. pp. 9, 102, 175, 211.

ANIMAL LIFE OF THE CUYAMACA MOUNTAINS. By Dr. J. G. Cooper. p. 14.

ON THE RELATIONSHIP BETWEEN DEVELOPMENT AND THE SEXUAL CONDITION IN PLANTS. By John Stockton-Hough, M.D. p. 19.

RAMBLES OF A BOTANIST IN WYOMING TERRITORY. By Rev. E. L. Greene. pp. 31, 208.

THE PRESENT ASPECTS OF BIOLOGY AND THE METHOD OF BIOLOGICAL STUDY. By Professor Allman. p. 34.

THE YELLOWSTONE NATIONAL PARK. By Theodore B. Comstock, B. S. pp. 65, 155.

ON THE STRUCTURE AND AFFINITIES OF THE BRONTOTHERIDÆ. By Prof. O. C. Marsh. *With two plates.* p. 79.

THE BOTANY OF THE CUYAMACA MOUNTAINS. By J. G. Cooper, M. D. p. 90.

SCIENCE IN THE UNITED STATES. From the French of Alphonse DeCandolle. p. 98.

NOTES UPON AMERICAN WATER BIRDS. By Robert Ridgway. p. 108.

THREE DIFFERENT MODES OF TEETHING AMONG SELACHIANS. By Prof. Louis Agassiz. p. 129.

THE WILD CATTLE OF SCOTLAND, OR WHITE FOREST BREED. By E. Lewis Sturtevant. p. 135.

EXPLORATION OF THE GULF OF MAINE WITH THE DREDGE. By A. S. Packard, Jr. *Illustrated.* p. 145.

THE GIANT CUTTLE-FISHES OF NEWFOUNDLAND AND THE COMMON SQUIDS OF THE NEW ENGLAND COAST. By Prof. A. E. Verrill. *Illustrated.* p. 167.

THE FLORA OF PENIKESE ISLAND. By Prof. D. S. Jordan. p. 193.

ON LOCAL VARIATIONS IN THE NOTES AND NESTING HABITS OF BIRDS. By Robert Ridgway. p. 197.

A NEW SPECIES OF WILLOW FROM CALIFORNIA, AND NOTES ON SOME OTHER NORTH AMERICAN SPECIES. By M. S. Bebb. p. 202.

THE ROBIN. By Caroline Boyce. p. 203.

THE NATURAL HISTORY OF A POLYMORPHIC BUTTERFLY. By Samuel H. Scudder. p. 257.

THE GAME FALCONS OF NEW ENGLAND. THE SPARROW HAWK. By Dr. William Wood. p. 266.

NATURE'S MEANS OF LIMITING THE NUMBERS OF INSECTS. By A. S. Packard, Jr. *Illustrated.* p. 270.

HABITS AND CHARACTERISTICS OF SWAINSON'S BUZZARD. By Dr. Elliott Coues. p. 282.

FOSSIL HORSES IN AMERICA. By Prof. O. C. Marsh. *Illustrated.* p. 288.

THE PRESERVATION OF CATERPILLARS BY INFLATION. By Samuel H. Scudder. *Illustrated.* p. 321.

NOTES ON THE CYPRINOIDS OF CENTRAL NEW JERSEY. By Charles C. Abbott, M.D. *Illustrated.* p. 326.

THE MIGRATION OF BIRDS. By T. Martin Trippe. p. 338.

ON THE STRUCTURE AND CASTING OF THE ANTLERS OF DEER. By John Dean Caton, LL. D. p. 348.

THE CLASSIFICATION OF THE RHYNCHOPHOROUS COLEOPTERA. By John L. LeConte, M. D. p. 385. Concluded p. 452.

OBSERVATIONS ON DROSERA FILIFORMIS. By William M. Canby. p. 396.

A KEY TO THE HIGHER ALGÆ OF THE ATLANTIC COAST, BETWEEN NEWFOUNDLAND AND FLORIDA. By Prof. D. S. Jordan. pp. 398, 479.

HUMAN REMAINS IN THE SHELL-HEAPS OF THE ST. JOHN'S RIVER, EAST FLORIDA. CANNIBALISM. By Prof. J. Wyman. p. 403.

THE HISTORY OF THE LOBSTER. By A. S. Packard, Jr. *With plate and cut.* p. 414.

NOTES ON THE FLORA OF SOUTHERN FLORIDA. By Frederick Brendel. p. 449.

HERBARIUM CASES. By Dr. C. C. Parry. *With cut.* p. 471.

CHARLES ROBERT DARWIN. By Prof. Asa Gray. p. 473.

THE AGRICULTURAL ANT. By Dr. G. Lincecum. p. 513.

AZALEA VISCOSA, A FLYCATCHER. By W. W. Bailey. p. 517.

ON THE ANTENNÆ IN THE LEPIDOPTERA. By A. R. Grote, A.M. p. 519.

THE SOCIAL LIFE OF THE LOWER ANIMALS. By Prof. P. J. Van Beneden. p. 521.

ON THE DISTRIBUTION AND PRIMITIVE NUMBER OF SPIRACLES IN INSECTS. By A. S. Packard, Jr. p. 531.

GEOGRAPHICAL VARIATION IN NORTH AMERICAN BIRDS. By J. A. Allen. p. 534.

EXPERIMENTS ON THE SUPPOSED AUDITORY APPARATUS OF THE MOSQUITO. By Prof. A. M. Mayer. *Illustrated.* p. 577.

THE GOSSAMER SPIDER. By Dr. G. Lincecum. p. 593.

ON THE NESTING OF CERTAIN HAWKS, ETC. By Dr. Elliott Coues, U.S.A. p. 596.

THE METAMORPHOSIS OF FLIES. I, II, III. By Dr. August Weissmann. pp. 603, 661, 713.

ADDRESS OF PROF. JOSEPH LOVERING. pp. 612, 641.

ENGLISH SPARROWS. By Thomas G. Gentry. p. 667.

IMBRICATIVE ÆSTIVATION. By A. P. Morgan. *With cuts.* p. 705.

ON THE COTTON WORM OF THE SOUTHERN STATES (*Aletia argillacea* Hüb.). By Aug. R. Grote. p. 722.

LIFE HISTORIES OF THE PROTOZOA. By A. S. Packard, Jr. *Illustrated.* p. 728.

## REVIEWS AND BOOK NOTICES.

The Systematic Position of the Brachiopods (*Illustrated*) p. 43. North American Grasshoppers, p. 53. British Marine Seaweeds, p. 54. Lubbock's Monograph of the Poduræ, p. 54. New German Botanical Manuals, p. 115. The Mollusks of Western North America, p. 116. The Zoological Record for 1871, p. 180. Revision of the Echini, p. 215. Hayden's Geology of the Territories (*Illustrated*), p. 216. Girard's Insects, p. 221. Solar Physics, p. 222. The Birth of Chemistry, p. 222. North American Moths, p. 223. Surveys west of the 100th Meridian, p. 302. Check List of Coleoptera, p. 303. Dictionary of Elevations of the United States, p. 303. Flora of Colorado, p. 304. Young's Physical Geography, p. 353. Half Hours with the Microscope, p. 354. Field Ornithology, p. 418. The Butterflies of North America, p. 420. Deep Sea Floridan Polyzoa, p. 421. The Publications of the Buffalo Society of Natural Sciences, p. 421. List of North American Noctuid Moths, p. 421. The United States Fish Commission Report (*Illustrated*), p. 493. North American Flies, p. 497. The Unicellular Nature of the Infusoria, p. 498. Siebold's Anatomy of the Invertebrates, p. 499. Recent Publications on Ornithology, p. 541. History of North American Birds, p. 546. The Principles of Science, p. 628. Scammon's Marine Mammals of the Northwestern Coast and American Whale-fishery, p. 632. The Geology of the Lower Amazonas (*Illustrated*), p. 673. The original Distinction of the Testicle and Ovary, p. 680. Maps of Wheeler's Expedition, p. 683. Physiology of the Circulation, p. 684. Bulletin of the Cornell University, p. 684. Manual of Metallurgy, p. 684. Introduction to General Biology, p. 749. Publications of Wheeler's Survey, p. 749. The Geological Survey of Indiana, p. 749.

## BOTANY.

Irritability of the Leaves of the Sundew, p. 55. Were the Fruits Made for Man, or Did Man Make the Fruits? p. 116. The Fertilization of Gentians by Humble Bees, pp. 180, 226. The Desmids, p. 181. Investigations respecting the Fertilization of Abutilon, p. 223. Abnormal Form of Allosorus acrostichoides, p. 304. Rumex patientia L. p. 305. The Northernmost flowering Plants, p. 305. The small-flowered Parnassia in Michigan, p. 305. The Fresh-water Algæ of North America, p. 306. Aplectrum hyemale again, p. 307. Development of Ferns without Fertilization, p. 307. Lobelia syphiliticæ v. alba, p. 307. Sex in Plants, p. 355. A New Ribes, p. 358. Periodic Motions of Leaves and Petals, p. 359. Ascent of Sap in the Bark of Trees, p. 360. Botrychium lunaria Swartz, in Michigan, p. 360. Absorption of Ammonia by the aërial parts of Plants, p. 360. Geographical Distribution of the Cupuliferæ, p. 422. Note on the Influence of Light on the Development of Plants, p. 425. Dr. Beardslee, p. 499. Double Thalictrum, p. 499. Dr. W. G. Farlow, p. 499. Distribution of Alpine Plants, p. 552. Amount of Water contained in the different parts of a Plant, p. 553. Botany of Wilkes' South Pacific Exploring

Expedition, p. 635. Influence of Forests on the Rainfall, p. 635. Insectivorous Plants, p. 684. Distribution of American Woodlands, p. 687. Adoxa Moschatellina L., in Iowa, p. 690. Dispersion of Seeds by shooting them off, p. 690. Botrychium lunaria Swartz, p. 691. Yucca filamentosa, p. 749. The Distinctive Features of Apple Flowers, p. 752.

## ZOOLOGY.

A New Ægerian Maple Borer, p. 57. A Spinous Fin in a Minnow, p. 58. Capture of a Gigantic Squid at Newfoundland, p. 120. A New (?) Ægerian Maple Borer, p. 123. The Anatomy of Worms, p. 124. Entomology in Missouri, p. 181. A New North American Bird, p. 188. Economic Entomology, p. 189. Gigantic Cuttle-fishes of Newfoundland, p. 226. Laws of Geographical Variation in North American Mammals and Birds, p. 227. The Habits of Polistes and Pelopæus, p. 229. Notes on the Plant Lice, p. 231. A Straggler in the Ohio, p. 233. Assembling among Moths, p. 234. Organs of Hearing in Insects, p. 236. Change of Habit, p. 237. Spontaneous Generation, p. 238. Discovery of the Water Thrush's Nest in New England, p. 238. Two rare Owls from Arizona, p. 239. Avifauna of Colorado and Wyoming, p. 240. The Olive-sided Flycatcher, p. 240. A remarkable Peculiarity of Centrocercus urophasianus, p. 240. On a Hummingbird new to our Fauna, p. 241. Occurrence of Telea Polyphemus in California.—A Correction, p. 243. Identity of our Hydra with European Species, p. 244. Olive-sided Flycatcher, pp. 308, 309. Pet Spiders, p. 361. Reproduction of a Fish's Tail, p. 363. The Kinglets in New Jersey, p. 364. The Honey-ants, p. 365. Spizella Breweri (?) in Massachusetts, p. 366. The Chimney Swift; Change in Place of Nesting, p. 367. The Myriopod Cermatia poisonous, p. 368. Blind Crustacea, p. 368. Birds and Caterpillars, p. 368. A sinistral Helix albolabris, p. 368. Note on preserving Insects in Collections, p. 369. The Structure of Sponges, p. 425. Haeckel's Embryonal and Ancestral form of all Animals, p. 426. Temperature and Life of the Arctic Ocean, p. 426. A Worm with External Ovaries, p. 427. A Remarkable Beetle Parasite of the Beaver (with cut), p. 427. Tornaria not a larval Starfish, but the Young of a Worm, p. 429. The White-necked Raven, p. 429. Relation of the Cœlenterates and Echinoderms, p. 430. New Carboniferous Myriopods from Nova Scotia, p. 430. The Discovery of the Origin of the Sting of the Bee, p. 431. Deep Sea Dredgings in the Gulf of St. Lawrence, p. 431. The Mouth Parts of the Dragon Fly, p. 432. A New Type of Snakes, p. 432 Notice of a Species of Tern new to the Atlantic Coast of North America, p. 433. The Ruddy Duck, p. 433. Birds New to the Fauna of North America, p. 434. On Some of the Evidences of Life in Great Salt Lake, p. 435. English Sparrows, p. 436. A New Group of Cyprinidæ, p. 436. A Horned Elotherium, p. 437. The Skunk, p. 437. The Redheaded Woodpecker in Maine, p. 437. Menobranchus edible, p. 438. New Crustacea of the Swedish Josephine Expedition, p. 438. Special Mode of Development of certain Batrachians, p. 438. The Paleontological History of

Trilobites, etc., as opposed by Barrande, to the Evolution Theory, p. 439. Monograph of the Whale Lice, p. 441. New Species of North American Bird, p. 500. Occurrence of Japyx in the United States (*Illustrated*), p. 501. The "Hateful" Grasshopper in New England, p. 502. The Kinglets in New Jersey, p. 502. Zoology in Belgium, p. 503. Recent Researches on Termites and Stingless Honey-bees, p. 553. The European House Sparrow, p. 556. Fish Culture in the Olden Time, p. 557. The Influence of the Nerves upon the Change of Color of Fish and Crustacea, p. 559. The Cotton Worm, p. 562. Larvæ of Anopthalmus and Adelops, p. 562. New Variety of Blue Grosbeak, p. 563. Dimorphism in Gall Flies, p. 563. Sweet Scented Ants, p. 564. Robber Ants, p. 564. Ichneumon Parasites of Anthrenus Larvæ, p. 564. Larvæ of Membracis serving as milk cattle to a Bee, p. 565. The Snow Goose, p. 636. Transformations of our Moths (*Illustrated*), p. 691. English Sparrows, p. 692. Monstrosities among Beetles, p. 693. Note on the Synonymy of Telea Polyphemus, p. 753. The Reversion of Thoroughbred Animals, p. 754. Deep Sea Explorations, p. 755. The Chestnut sided Warbler, p. 756. Embryology of the Brachiopods, p. 756. Metamorphoses of the Hair Worm, p. 757. A new Order of Hydrozoa, p. 757. Birds of Kansas, p. 757. Ostrich Breeding, p. 757. Case of a Dog nursing a Kitten, p. 758.

## GEOLOGY.

Return of Professor Marsh's Expedition, p. 58. The N. W. Wyoming Expedition, p. 124. Monkeys in the American Miocene, p. 125. The Genus Protohippus, p. 126. Remains of Land Plants in the Lower Silurian, p. 190. The great Lava-flood of the West, p. 244. Deep-sea Explorations, p. 369. The Carboniferous Formation of South America, p. 441. Analogy of the Tertiary Fauna of France to the Temperate Regions of America, p. 442. Small size of the Brain in Tertiary Mammals, p. 503. Deep Sea Soundings, p. 504. Deep sea Temperature in the Antarctic Sea, p. 637. Origin of the Valley of the Rhine, p. 637. Supposed Lower Silurian Land Plants, p. 693. European Fossil Cetacea, p. 694.

## ANTHROPOLOGY.

The Manufacture of Pottery by the Indians (*Illustrated*), p. 245. The Berries of Rhamnus croceus as Indian Food, p. 247. A human Skeleton from the Diluvium, p. 370. The Pygmies of Central Africa, p. 443. Troglodytes in Alaska, p. 505. Egyptian Archæology, p. 506. A true Geography of the Brain, p. 565. Rate of Growth in Man, p. 567. Extent of the Ancient Civilization of Peru, p. 637. Restoration of Indian Pottery, p. 694. The Earthworks of Fort Ancient, p. 759.

## MICROSCOPY.

A New Section Cutter (*Illustrated*), p. 59. A New Form of Microtome (*Illustrated*), p. 126. Embedding Tissues for Sections, p. 191. Dissecting Embryos, p. 191. Holman's Siphon Slide (*Illustrated*), p. 248. Structure

of the Potato, p. 248. Microscopic Drawing, p. 249. Air-cells in a floating Leaf, p. 250. Life of Hæmatozoa, p. 250. Finding the chemical Focus in Photomicrography, p. 251. A Spherical Diaphragm, p. 252. Leaf Sections, p. 252. Another Erector, p. 252. Cements, p. 252. Automicroscopy, p. 253. Measuring the growth-rate of Plants, p. 253. A revolving Amplifier, p. 253. Quieting Frogs, p. 253. On the Structure of Diatoms, p. 309. Unmounted Objects, p. 316. Arranging Diatomaceæ (*Illustrated*), p. 371. Histology, p. 373. Morphology of the Saprolegniei, p. 374. Section Cutters, p. 375. Lecture Illustrations of Microscopic Objects, p. 375. Podura Scales, p. 376. Lengthened Immersion Tube, p. 376. Automatic Turntable, p. 376. Origin of Blood Corpuscles, p. 376. Substitute for the Camera lucida, p. 377. Amphipleura pellucida in dots, p. 443. On Circulatory Movements in Vaucheria, p. 444. Improvements in Insect Mounting, p. 507. Measuring Angular Apertures, p. 508. Cataloguing Microscopic Specimens, p. 509. Sand-blast Cells, p. 510. Another Microscopical Cement, p. 510. New Application of Staining to Pathology, p. 511. New Rotating Microscope, p 567. Mounting Diatoms, p. 568. Blood Crystals, p. 568. Tolles' New Immersion 1-6th, p. 568. Sphæraphides in Tea Leaves, p. 638. New Microscopical Societies, p. 638. Appearance of the Blood in Melanosis, p. 638. Achromatic Bull's Eye Condenser, p. 638. Embedding Tissues, p. 639. Glycerine Mounting, p. 639. Beaded Silica Films, p. 696. Cell-culture in the Study of Fungi, p. 697. Handling Diatoms, p. 697. Reproduction of Desmids, p. 698. Angular Apertures, p. 698. A Finder for Microscopes with plain stage, p. 700. The Right-angled Prism as a substitute for the Mirror for transmitted light, p. 700. Apparatus for giving pressure to objects while drying, p. 700. The new Type Plate, p. 701. Fixing Diatoms, p. 701. The Podura Scale, p. 702. Distribution of the Rhizopods, p. 761.

NOTES.—Pages 62, 128, 191, 253, 316, 377, 445, 511, 569, 639, 702, 762.

EXCHANGES. — Pages 256, 448.

BOOKS RECEIVED.—Pages 64, 128, 192, 256, 320, 384, 448, 512, 576, 704, 765.

ANSWERS TO CORRESPONDENTS. — Page 128.

## ERRATA.

Page 58, line 10, for "Germadius" read Gennadius. Page 114, line 3 from bottom, for "arising" read arriving. Page 115, for "Thorne" read Thomé. Page 237, last line, for "I. J. Wyman" read J. Wyman. Page 358, in the description of *Ribes Wolfii*, immediately after sp. n. insert (*R. Sanguineum* Pursh. var. variegatum Watson, 381 in King's Report, vol. v, p. 100) and change "3 to 6 feet high" into 2 to 4 feet high. Page 482, after the second "c" read "Branchlets mostly tapering to base." omitting "opposite and." Page 483, line 30 from top, for "g" read q. Page 485, line 16 from top, for "f" read $f^2$. Page 491, for numbers "150, 151, 152, 153, etc., to 194," read Nos. 149(2), 150, 151, 152, etc., to 193, each number having been by accident pushed forward, thus not corresponding with the references above. Thus Ulva Lactuca should be No. 161 instead of No. "162." Page 509, line 15 from top, for "slip" read slit. Page 546, 3d line from bottom, insert a comma after "century." Page 547, 10th line from bottom, for "of which the latter two," read, of which latter two. Page 551, 5th line from bottom, for "subi" read subis; 4th line from bottom, insert "no" before "similar." Page 552, for "J. S. Merrill" read J. C. Merrill.

## LIST OF PLATES.


| Plate. | | Page. |
|---|---|---|
| 1, 2. | Brontotherium ingens Marsh, | 84 |
| 3. | Early Stages of the Lobster, | 416 |


## LIST OF WOOD-CUTS.


| No. | | Page. |
|---|---|---|
| 1. | Lingula pyramidata, | 44 |
| 2. | Transverse section of Lingula, | 44 |
| 3. | Transverse section of annelid, | 44 |
| 4. | Transverse section of molluscan archetype, | 44 |
| 5. | Molluscan archetype, | 44 |
| 6. | Embryo of Lamellibranchiate, | 45 |
| 7–11. | Embryos of worms, | 46 |
| 12–17. | Embryos of Brachiopods, | 46 |
| 18. | Peduncle of Lingula pyramidata, | 47 |
| 19. | Cephalic collar of Sabella, | 47 |
| 20. | Head of Discina, | 47 |
| 21. | Head of Sabella, | 47 |
| 22, 23. | Longitudinal section of Lingula and Amphitrite, | 48 |
| 24, 25. | Sections of arm of Amphitrite and Lingula, | 49 |
| 26–29. | Hairs of various shells and worms, | 49 |
| 30–34. | Segmental organs of worms, | 51 |
| 35–38. | Segmental organs of Brachiopods, | 51 |
| 39, 40. | Segmental organ of Alciope and Terebratulina, | 52 |
| 41–43. | Section cutter, | 60, 61 |
| 44. | Section of arm of squid, | 122 |
| 45. | Microtome, | 126 |
| 46. | Aporrhais occidentalis, | 128 |
| 47. | Yoldia thracæformis, | 128 |
| 48. | Macoma sabulosa, | 128 |
| 49. | Mactra ovalis, | 151 |
| 50. | Cyprina Islandica, | 151 |
| 51. | Glycimeris siliqua, | 152 |
| 52. | Panopæa Norvegica, | 152 |
| 53. | Deltocyathus Agassizii, | 153 |
| 54. | Loligo pallida, | 168 |
| 55. | Quill of Loligo pallida, | 169 |
| 56. | Egg Capsule of Loligo Pealii, | 170 |
| 57. | Embryo of Loligo Pealii, | 171 |
| 58. | Geyser-tube, | 216 |
| 59. | Turban Geyser, | 216 |
| 60. | Oblong Geyser near the Giant, | 217 |
| 61. | Basins of Hot Springs, | 218 |
| 62. | Menopon picicola, | 219 |
| 63. | Goniodes Merriamanus, | 219 |
| 64. | Goniodes mephitidis, | 220 |
| 65. | Nirmus buteonivorus, | 220 |
| 66. | Docophorus syrnii, | 220 |
| 67. | Cattle Tick, | 220 |
| 68. | American Argas, | 220 |
| 69–70. | Indian implements, | 245 |
| 71. | Siphon slide, | 248 |
| 72. | Aphelinus of apple scale insect, | 281 |
| 73. | Orohippus agilis, | 289 |
| 74. | Miohippus annectens, | 290 |
| 75. | Foot bones of Orohippus, Miohippus, Hipparion, & Equus, | 292 |
| 76–77. | Preservation of caterpillars, | 322 |
| 78. | Alburnus amœnus, | 334 |
| 79–80. | Instruments for arranging Diatomaceæ, | 372 |
| 81. | Embryo of lobster, | 415 |
| 82. | Platypsylla castoris, | 428 |
| 83. | Herbarium cases, | 472 |
| 84. | Lerneonema, | 497 |
| 85–86. | Cirrhatulus grandis, | 494 |
| 87. | Clymenella, | 494 |
| 88. | Euchone, | 497 |
| 89. | Zoëa of common crab, | 495 |
| 90. | Megalops of common crab, | 495 |
| 91. | Japyx solifugus, | 501 |
| 92–100. | Geological Sketches of the Lower Amazonas, | 674–679 |
| 101. | Larva of Cælodasys unicornis, | 691 |
| 102. | Larva of Platycerura furcilla, | 691 |
| 103. | Larva of Nadata gibbosa, | 691 |
| 104–105. | Larva of Notodonta, | 691 |
| 106. | Larva of Cerura, | 692 |
| 107. | " " Diphtera deridens, | 692 |
| 108. | Cucullia speyeri, Male, | 692 |
| 109. | " " Female, | 692 |
| 110–125. | Æstivation of Plants, | 706–709 |
| 126. | Bathybius Hæckelii, | 730 |
| 127. | Protomonas amylı, | 732 |
| 128. | Protomyxa aurantiaca, | 733 |
| 129. | Vampyrellas pirogyræ, | 735 |
| 130. | Myxastrum radians, | 736 |
| 131. | Gregarina gigantea, | 738 |
| 132. | Amœba diffluens, | 741 |
| 133. | Amœba sphærococcus, | 744 |
| 134. | Pelomyxa palustris, | 745 |
| 135. | Collosphæra spinosa, | 747 |

THE

# AMERICAN NATURALIST.

Vol. VIII.—JANUARY, 1874.—No. 1.

## NOTES FROM THE JOURNAL OF A BOTANIST IN EUROPE.

BY W. G. FARLOW, M.D.

### PART I. SWEDEN.

SWEDEN, and especially Upsala, is a sort of botanical Mecca, and, indeed, no one who has occasion to travel in the north of Europe would willingly refrain from visiting the tomb of Linnæus.

I reached this country by way of Copenhagen, which fine city, as well as Hamburg I was obliged to hurry through, taking merely a glimpse of the Botanical and Zoological Gardens. From Copenhagen I crossed over to Malmoe in Sweden, and took the train to the old university town of Lund, where the distinguished algologist, Agardh, is professor, as was his father before him. The town is, indeed, old and primitive: and from the astonishment of the natives one would suppose that I was the first American ever seen there.

A pretty, but to me decidedly unintelligible chamber-maid managed after a while to understand that I wanted a room. Unfortunately, there was no lock to the door, and servant after servant entered the room without going through the ceremony of knocking, and inspected me and my luggage. At length, a waiter appeared who spoke a little German and from him I learned that Prof. Agardh was in the city. With a porter to carry my large package of algæ, I made my way to his house, before the door of

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which, and in the entries, juniper twigs were spread, a universal custom in Sweden. I found the professor at home and expecting me. In personal appearance he is tall, and, as they say, aristocratic looking (in fact he is called "Lord Agardh" by the students); he has bright twinkling eyes and a white mustache. He speaks and writes English remarkably well. He is a member of the Reichstag, and so goes to Stockholm in the winter. His herbarium, with the exception of the largest species, is in his private house. The larger specimens are kept at the building in the new botanical garden. An examination of the specimens I had brought was preluded by an invitation to take a glass of Cognac and soda-water, a favorite beverage in this region. My valise being unpacked, we set to work. Amongst the lot were several plants new to him from America, and some entirely new, particularly amongst my Oregon and California species; but this is hardly a proper time to notice new species. He seemed to be particularly interested in a specimen of *Pikea Californica*, which plant he had never seen, although he had himself added other members to the genus. A *Chordaria* from Oregon, supposed by Agardh to be new, I have since discovered, from an examination of the Ruprecht collection in St. Petersburg, to be *C. abietina* of Ruprecht, still unpublished.

The botanical department of the university is under the direction of Professor Agardh, assistant Professor Areschoug, nephew of the professor of the same name at Upsala, and Dr. Berghen, *privat-docent*, who has more especially studied mosses and was associated with Professor Theo. Fries of Upsala in his Spitzbergen journey. Dr. Areschoug speaks very little English, but delightfully slow German. Dr. Berghen speaks both English and German. He is going to New Zealand next year, and is to return by way of California.

The old botanical garden opposite the cathedral is now changed into a pleasure ground. The new garden is yet in its infancy, but the hot-houses are on a scale not to be seen in any American university. It seems strange to me that in these cold northern countries, among a comparatively poor people, the universities are provided with gardens and hot-houses which, if they belonged to most American universities, would be considered something wonderful. In fact, except in Berlin and Munich, I have seen no garden in Germany, so far as the hot-houses are concerned,

equal to those at Lund. Near the entrance of the garden is a brick building containing a lecture room, laboratory, and herbarium. In passing through the hall a most decided and congenial aroma of seaweed was perceived. It appears that Professor Agardh keeps a woman pretty constantly employed in soaking out and mounting rough-dried specimens. During my visit, she was engaged on a lot of algæ sent by Dr. Ferd. Müller of Australia, and, as I entered the room, she was fishing up a specimen of *Phacelocarpus Labillardieri*. In this building are kept large specimens of Ecklonia, Macrocystis, Durvillæa, etc., several feet long, mounted on very thick card-board. That is certainly the only way of getting any idea how such plants really look.

Lund lies in the large plain of Sarnia, with mountains visible in the distance. This is decidedly the most fertile part of Sweden, and the grain crop is very large. I made an excursion with Dr. Berghen to a place called Vogelsang, made classic by the visits of Linnæus. The meadows and knolls were very beautiful with centaureæ and orchids, and farther off one could see the grain fields brilliant with the usual amount of poppies, chrysanthemums, and bachelor's buttons, the characteristic "corn-weeds" of Europe.

From Lund to Stockholm is a rather long journey, particularly if one has lately been travelling in Germany. The botanists of Stockholm were all away for the vacation. So, after visiting the museum and galleries, which, although good, are not remarkable, and enjoying for a day or two this picturesque and agreeable city and its surroundings, I went on to Upsala, in the slowest train I ever saw. Upsala is not so beautifully situated, but is in most respects more interesting than Lund. The number of students is fifteen hundred, three times as great as at Lund. Many of the students are poor and are obliged to spend the vacations in Upsala, only returning home at the completion of their studies. They are divided according to the nations or provinces of Sweden, each of which has a club house, that of the Stockholm-nation being the finest. Each nation has also a lot and monument in the cemetery, and most of the students who die at Upsala are buried there, as it is a long journey to some of the provinces. In fact, Americans who judge of European distances from Great Britain and Germany are astonished at the size of Norway and Sweden. Professor Schübler of Christiania told me that it was half as far

from Christiania to the northernmost point of Norway as from Christiania to Rome.

On my arrival I called at once on the venerable Professor Fries. I found him at home, surrounded by his children and grandchildren, assembled to celebrate his seventy-eighth birthday. Only one of his family was absent, a son who lives in Florida. He welcomed me warmly, and regretted that he was too feeble to show me Upsala. He spoke German, but so slowly that it was difficult to follow him. His daughters spoke English; the youngest, who is unmarried, very well. He wears the traditional long black coat and skull-cap, and has the venerable appearance and benign expression, which is shown in the photograph of himself and the amiable Madame Fries, which I remember in Professor Gray's collection. Professor Fries directed me to the college building where his son resides, and told me that he would be glad to act as my escort in Upsala. The way to the laboratory was through very classic grounds. Just back of the castle is the Library, Carolina Rediviva, with an avenue to the right leading to the Obelisk and the Cathedral. Here are some fine trees, and it has been the favorite walk of many distinguished professors. Back of the library is a large grove with a cemetery in which are buried Wahlenberg and Thunberg. In the grove and cemetery are a number of Runic monuments, and through the centre of the grove runs a broad avenue to the laboratory, in the second story of which several of the professors have suites of rooms. Not finding Professor Fries at home I called again the next morning.

The younger Professor Theodore Fries, stout and robust, and not the least like his father in personal appearance, kindly offered to be my guide in the city. The situation of Upsala is bleak and even dismal, a single hill on which stands the cathedral, castle and university buildings, in the midst of a wide plain. The cathedral, an ancient brick structure, has no great claims to beauty, but is chiefly interesting on account of the tombs and relics contained in it. The tomb of Gustav Vasa is the lion of the place, but to all naturalists the tomb of Linnæus, of black marble with a medallion, is the chief attraction. The design is simple, and in striking contrast to the elaborate sculptures sacred to the memory of some very noble but now completely forgotten individuals. In front of the cathedral is a promenade respected

by the inhabitants as the favorite resort of the professors. The promenade ends at the library, the first of the university buildings, back of which, and separated from it by a grove in which are stones with curious Runic inscriptions, is a large building containing the university laboratories. Close by is the Botanical Garden, where strangers are shown Linnæus's myrtle, which is still kept alive for the purpose of supplying travellers with relics. In this way the more valuable mementoes of Linnæus are preserved from the ravages of curiosity hunters. In the hall of the herbarium building is a marble statue of the father of botany, in a sitting posture, by Byström. The expression of the face is extremely beautiful, but unfortunately not very much like Linnæus, if we are to trust the portrait at Stockholm, which was considered an excellent likeness. Professor Areschoug, best known by his algological writings, resides close to the garden. He is a rather short, thick-set man, and in his method of study is decidedly German. His collection of microscopic preparations of algæ is large, and the preparations are beautifully mounted.

Linnæus' city house, at the old Botanic Garden, is still to be seen, nearly unaltered, but it contains no relics of its distinguished owner. There are some, however, at his country house at Hammarby, five miles from town, and in the little building near it which contained his herbarium and museum. A good idea of these and of all the souvenirs of Linnæus is to be had from a series of fifteen small photographs, with an accompanying sheet of letter press, which were published a few years ago, and are still on sale. The collection was advertised at the time in most of the botanical journals, is not expensive, and could readily be obtained, I presume, by those who would be interested in these memorials. A visit to Upsala is incomplete without an excursion to the tombs of Thor, Frei and Odin, three mounds a short distance from the town. To make the scene more impressive, the Swedish urchins roll over and over down the mounds for a slight gratuity. At a restaurant near by, one is also expected to drink mead out of horns mounted with silver and inscribed with the names of princes and nobles who drank heavily from them in days of yore.

# ORNITHOLOGICAL NOTES FROM THE SOUTH.

BY C. HARTE MERRIAM.

## I. SOUTH CAROLINA.

THE town of Aiken is situated in the dry, sandy "Pine Barrens" of southern South Carolina. It is a great resort for invalids (especially for those suffering from pulmonary diseases), the climate being dry and healthful. It is the highest point on the Charleston railroad, having an altitude of over six hundred feet, and there are no streams or swamps in the vicinity. There is no water near excepting an exceedingly small stream which flows into a little pond two miles distant, the outlet of which empties into several larger ponds between Graniteville and Langley, five and eight miles west of the town.

The woods, which consist mainly of pine trees, abound with bright green lizards (*Anolius Carolinensis*), which, like the chameleon, possess the power of changing their color to a greenish-yellow and a dark reddish-brown. There is also another species of lizard (*Scleroporus undulatus*), which somewhat resembles the "horned toad" of our western plains; it is longer, however, and more slender and its throat and the sides of its belly are of a bright metallic greenish-blue color. Both of these species run about on old logs and rail fences and seem to take especial delight in climbing among the fragrant jessamines (*Gelsemium sempervirens*), which are very abundant in some parts of the woods. When disturbed they generally take to some tree, which they climb with astonishing rapidity; the back of the latter species so closely resembles the bark as to be scarcely distinguishable from it.

To the entomologist, Aiken may prove a more fruitful locality than to the ornithologist, since there are many bright colored and beautiful species of butterflies; but even these lose their attractions when compared with the endless varieties and curiously formed species of Coleoptera. One species of the latter in particular (*Phanæus carnifex*) reminds us of the Brazilian beetles; it is about three-quarters of an inch long, is of the brightest green color, and has a large reddish violet shield on the fore part of its back, out of which grows an immense horn that hangs over the back.

Now, after having given the readers of the NATURALIST a general idea of the locality, I will proceed to consider my more particular friends, the birds.

Arriving at Aiken on the 14th of March, I commenced collecting on the same day, and remained there three weeks, during which time one hundred and fifty-three specimens were prepared. Owing to the unusual tardiness of the season, many, and in fact most, of the spring birds had not arrived up to the time of leaving. About the 14th of March, I found the yellow-rumped warbler (*Dendrœca coronata*) very abundant: on the 17th the pine-creeping warbler (*D. pinus*) first made its appearance, after which time it was quite common; it was very appropriately named the *pine*-creeping warbler, as I never, except on one occasion, saw it alight, even for an instant, on anything but a pine tree; here it would sit by the hour and warble out its sweet song. On the 21st, I heard a delicate chirp above my head, and, looking up, saw a small bird on the top of one of the tallest pine trees; it was too high to be recognized, so I shot it, and found to my great delight that it was the yellow-throated warbler (*D. Dominica*). The black and white creeper (*Mniotilta varia*) was seen on the 18th, from which time afterwards it was common. A few Maryland yellow-throats (*Geothlypis trichas*) arrived on the 31st, but were not numerous. The hermit thrush (*Turdus Pallasii*) and the robin (*Planesticus migratorius*) were quite plentiful when I arrived. Mocking birds (*Mimus polyglottus*) did not become numerous until about the 25th, after which time they "fairly filled the air with their rich medley of inexhaustibly varied notes, the singers leaping in restless ecstasy from branch to branch, with drooping wings and spread tail, or flitting from thicket to thicket as they sang." I observed but one cat-bird (*Galeoscoptes Carolinensis*) and that was on the 4th of April; the brown thrush or long-tailed thrasher (*Harporhynchus rufus*) was very common on and after March 19th.

I shot a pewee or phœbe bird (*Sayornis fuscus*) on the 15th, after which time they were often seen. Our common kingbird, or beebird (*Tyrannus Carolinensis*) arrived on the 4th of April, when it immediately commenced its usual noisy abuse of all the other species, both large and small, especially the former. On the 22d, I shot one blue-headed vireo (*Vireo solitarius*), which was the only one seen; the white-eyed vireo (*V. Noveboracensis*), however, was quite common on and after the 27th. The great Carolina

wren (*Thryothorus Ludovicianus*), though a resident, was first observed about the 27th, after which time its pleasant song was often heard. The blue-gray gnatcatchers (*Polioptila cærulea*) arrived on the 21st, and soon became very common; the ruby-crowned kinglets (*Regulus calendula*) appeared on the same day, and were equally numerous. Rough-winged swallows (*Stelgidopteryx serripennis*), in large numbers, arrived about the 22d. Hawks of all kinds were rare; one fish hawk (*Pandion Carolinensis*) was observed at Langley's Pond eight miles below here, and occasionally a *Buteo* was seen sailing above Aiken, but too high for the species to be determined. Bluebirds (*Sialia sialis*) were quite plentiful and were probably resident; they commenced nesting about the 1st of April, as did the blue jays and Carolina chickadees. I shot one loggerhead shrike (*Collurio Ludovicianus*); this species was quite rare. The common yellow bird (*Chrysomitris tristis*) was occasionally met with, and the pine finch (*C. pinus*) was very abundant. Chipping sparrows (*Spizella socialis*) were very plentiful, as were the field sparrows (*S. pusilla*), song sparrows (*Melospiza melodia*), white-throated sparrows (*Zonotrichia albicollis*), black or common snowbirds (*Junco hyemalis*), and the bay-winged bunting (*Pooecetes gramineus*).

The following is a list of the birds observed at Aiken, South Carolina, between March 14th and April 5th, 1873.

Turdus Pallasii Cab. (Hermit Thrush), abundant. 9 spns. procured.
Planesticus migratorius Linn. (Common Robin), common.
Mimus polyglottus Boie (Mocking Bird), arrived about March 25th, common. 1 spn.
Galeoscoptes Carolinensis Baird (Cat Bird), arrd. April 4, rare.
Sialia sialis Baird (Bluebird), abundant. 2 spns.
Regulus calendula Licht. (Ruby-crowned Kinglet), arrd. Mar. 21st, abundant. 6 spns.
Polioptila cærulea Sclat. (Blue-gray Gnatcatcher), arrd. March 21st, common. 4 spns.
Lophophanes bicolor Bonap. (Tufted Titmouse), very numerous. 12 spns.
Parus Carolinensis Aud. (Carolina Chickadee), common. 4 spns.
Sitta Carolinensis Gmelin (White-bellied Nuthatch), not common. 2 spns.
Sitta pusilla Latham (Brown-headed Nuthatch), rare. 2 spns.
Certhia Americana Bonap. (Brown Creeper), rather common. 2 spns.
Thryothorus Ludovicianus Bonap. (Gt. Carolina Wren), not common. 2 spns.
Geothlypis trichas Cab. (Maryland Yellow-throat), not common. 1 spn.
Dendrœca coronata Gray (Yellow-rumped Warbler), very common. 8 spns.
Dendrœca pinus Baird (Pine-creeping Warbler), arrd. March 17, common. 18 spns.
Dendrœca Dominica Baird (Yellow-throated Warbler), March 21st, rare. 1 spn.
Stelgidopteryx serripennis Baird (Rough-winged Swallow), arrd. March 22, common. 2 spns.
Vireo Noveboracensis Bonap. (White-eyed Vireo), arrd. March 27, very common. 3 spns.
Vireo solitarius Vieill. (Blue-headed Vireo), arrd. March 22, rare. 1 spn.
Collurio Ludovicianus Baird (Loggerhead Shrike), rare. 1 spn.
Chrysomitris tristis Bonap. (Yellowbird), not common. 2 spns.

Chrysomitris pinus Bonap. (Pine Finch), very abundant. 9 spns.
Poecetes gramineus Baird (Bay-winged Finch), common. 3 spns.
Zonotrichia albicollis Bonap. (White-throated Sparrow), abundant. 6 spns.
Junco hyemalis Sclat. (Snowbird), common. 2 spns.
Spizella pusilla Bonap. (Field Sparrow), common. 2 spns.
Spizella socialis Bonap. (Chipping Sparrow), common. 2 spns.
Melospiza melodia Baird (Song Sparrow), common. 2 spns.
Melospiza palustris Baird (Swamp Sparrow), rather common. 1 spn.
Cardinalis Virginianus Bonap. (Redbird), common. 6 spns.
Pipilo erythrophthalmus Vieill. (Chewink), common. 3 spns.
Agelæus phœniceus Vieill. (Red-winged Blackbird), not common. 1 spn.
Sturnella magna Sw. (Meadow Lark), not common.
Cyanura cristata Sw. (Blue Jay), common. 4 spns.
Corvus ossifragus Wilson (Fish Crow), not common.
Tyrannus Carolinensis Baird (King Bird), arrd. April 4, common. 1 spn.
Sayornis fuscus Baird (Pewee), common. 5 spns.
Ceryle alcyon Boie (Belted Kingfisher), rare.
Picus villosus Linn. (Hairy Woodpecker), rare. 1 spn.
Picus borealis Vieill. (Red-cockaded Woodpecker), rare. 1 spn.
Sphyropicus varius Baird (Yellow-bellied Woodpecker), common. 4 spns.
Melanerpes erythrocephalus Sw. (Yellow-bellied Woodpecker), not common. 1 spn.
Colaptes auratus Sw. (Yellow-shafted Flicker), common. 2 spns.
Hypotriorchis columbarius Gray (Pigeon Hawk), rare. 1 spn.
Tinnunculus sparverius Vieill. (Sparrow Hawk), not common. 1 spn.
Cathartes aura Illig. (Turkey Buzzard), common. 1 spn.
Cathartes atratus Lesson (Black Vulture), not common.
Zenædura Carolinensis Bonap. (Common Dove), common. 2 spns.
Ortyx Virginianus Bonap. (Common Quail), abundant. 1 spn.
Butorides virescens Bonap. (Green Heron), not common. 1 spn.
Ægialitis vociferus Cassin (Kildeer), not common.
Philohela minor Gray (American Woodcock), rare.
Tringoides macularius Gray (Spotted Sandpiper), not common.

## BOTANICAL OBSERVATIONS IN WESTERN WYOMING.

BY DR. C. C. PARRY.

### No. 1.

HAVING been connected with the exploring expedition of Captain W. A. Jones into Northwestern Wyoming during the past season (1873), the botanical results have proved of such unexpected interest that I have obtained the permission of Captain Jones to anticipate the more detailed official report by preparing for immediate publication a brief sketch of the general botanical features of the region passed over, with notices of rare plants and descriptions of new species collected on the route.

FORT BRIDGER TO CAMP BROWN. Leaving the point of rendezvous at Fort Bridger on the 12th of June, our route followed a

northeasterly course over Green River basin, thence skirting along the southern spurs of the Wind River range. The main continental divide was crossed at South Pass. From this point following a more direct northerly course we reached Camp Brown in the Wind River valley on July 1st.

The chief botanical interest on this portion of our route was comprised in the many suggestive associations with the early discoveries of Nuttall nearly forty years previous. Though this route has been repeatedly traversed by exploring parties, lying in fact on the well-beaten track of western emigrant travel previous to the construction of the Pacific Railroad, not a few of the plants then collected and described have remained up to this time *desiderata* in herbaria.

Unusually copious spring rains previous to our journey had freshened the vegetation of these usually arid tracts, so that our necessarily slow and tedious marches, encumbered by a heavily laden wagon train, were enlivened (at least to the botanist) by unwonted verdure. Even the repulsive "sage plains" and "grease wood" flats, so monotonous and forbidding to the ordinary traveller, yielded up unexpected treasures of rare plants. Among these the evanescent annuals were in great profusion, including *Cleome aurea* Hook., *Calyptridium roseum* S. Watson, *Œnothera Andina* Nutt., *Œnothera scapoidea* Nutt., *Astragalus Geyeri* Gray, *Astragalus pictus* Gray, *Chœnactis Douglasii* H. & A., *Plantago Patagonica* Jacq., *Gilia inconspicua* Dougl., and *Oxytheca dendroidea* Nutt. In the moist grassy valley of Little Sandy were also found quite abundantly *Capsella divaricata* Walp. and *Gentiana humilis* Stev., heretofore overlooked by collectors in this region.

Of perennial plants, serving somewhat to relieve the prevalent and monotonous growth of *Artemisia*, *Tetradymia* and *Linosyris*, comprising what is popularly known as "wild sage," and the equally forbidding Chenopodiaceous shrubs confounded under the common term of "grease-wood," may be noted several species of *Astragalus* including *A. Purshii* Dougl., *A. lotiflorus* Hook, *A. glareosus* Dougl., *A. junceus* Nutt., and now collected for the first time since Nuttall's original discovery, *A. pubentissimus* Nutt. and *A. flavus* Nutt., the former a not uncommon roadside plant, and the latter quite abundant along the margins of dry watercourses, at the foot of steep clay buttes.

On gravelly knolls adjoining Green River still another inter-

esting Nuttallian plant was rediscovered, *Tanacetum Nuttallii* Torr. & Gray, and growing in close proximity with this was found *Vesicaria Alpina* Nutt., both probably near the original station of Nuttall.

Nearly everywhere over this district in exposed situations we meet with *Eriogonum ovalifolium* Nutt., forming dense silvery cushions, its close globular heads of flowers exhibiting a great variety of tints from pure white to dark brown. Almost equally abundant on gravelly slopes also occur *Aplopappus acaulis* Gray, and *Astragalus simplicifolius* Gray, presenting a neat contrast of colors in their bright yellow and blue flowers, resting in mats of dark green and silvery foliage.

Quite constantly associated in growth with *Astragalus flavus* Nutt. is a showy asteroid plant with large white flowers, disposed in flattened summits surmounting the dull colored tomentose leaves. This plant, according to Dr. Gray, is closely allied to or perhaps identical with the *Xylorhiza villosa* Nutt. (*Aster Xylorhiza* Torr. & Gray). In view of the discrepancy in many respects between this plant and that described by Nuttall, Dr. Gray has thought proper to characterize it as a new species, *Aster Parryi*.

Among other plants worthy of note in this district may be enumerated *Delphinium Menziesii* DC., *Sisymbrium junceum* Bieb., *Viola Nuttallii* Pursh, *Cymopterus montanus* Nutt., *Cymopterus Fendleri* Gray, *Antennaria dimorpha* Nutt., *Artemisia pedatifida* Nutt., *Phlox longifolia* Nutt., *Phlox canescens* Torr. & Gray, *Castilleia parviflora* Bong., *Pentstemon humilis* Nutt., and *Gilia pungens* Benth.

On reaching the higher ground forming the eastern rim of the Green River basin, which leads by an easy pass, at an average elevation of seven thousand feet above the sea level, from the Pacific to the Atlantic slope, the prevalent desert growth gives place to a vegetation partaking of a sub-alpine character. This district comprises the botanical localities designated by Nuttall as "dry and lofty hills in the central range of the Rocky Mountains."

Here accordingly we again come within the range of these early discoveries in re-collecting such choice plants as *Draba Alpina* L., var. *densifolia*, *Lepidium montanum* Nutt., *Trifolium Andinum* Nutt., *Trifolium gymnocarpon* Nutt., *Astragalus campestris* Gray, *Oxytropis lagopus* Nutt., and *Phlox bryoides* Nutt.

Here also we meet for the first time, probably near its southeastern limits, the interesting *Lewisia rediviva* Pursh. This

becomes much more abundant farther north in the Wind River valley, and we were thus afforded an opportunity to observe this plant through its flowering and fruiting stages, extending from the latter part of June to the middle of July. After this latter period its matured capsules are detached and blown away, leaving no trace of the plant exposed to view, till the following spring develops the rosette of radical leaves, by which the Indians are guided in procuring their supplies of this palatable and nutritious root. Recent attempts have been made to introduce this showy plant into our gardens, where it would prove quite an acquisition.

Shrubbery is here represented mainly by *Rosaceæ*, including *Amelanchier Canadensis* Torr. & Gray, *Potentilla fruticosa* L., *Purshii tridentata* DC., *Ribes cereum* Dougl., but we look in vain, in apparently favorable localities, for the forms so well known in the mountain range farther south in Colorado of *Ribes deliciosus* Torr., *Cercocarpus parvifolius* Nutt., or *Jamesia Americana* Torr. & Gray.

The scanty pine growth includes chiefly *Pinus flexilis* James, with an occasional clump of *Abies Douglasii* Lindl., and *Juniperus Virginiana* L.

The southeastern spurs of the Wind River range present a succession of steep, grassy slopes agreeably interspersed with pine-clad ridges. Through numberless channels the mountain streams collect their summer tribute of melted snow, and cleave their way to the lower valleys through deep gorges, disclosing in steep mural faces the structure and succession of the underlying, highly inclined, rocky strata. The lower undulating slopes, forming the natural divides between the numerous watercourses tributary to the main valley of Wind River, form irregular ridges often presenting smooth tabled summits, bedded with rich grasses interspersed with gaily colored flowers. Conspicuous among the latter are the bright golden-yellow heads of *Balsamorhiza Hookeri* Nutt., and *Balsamorhiza sagittata* Nutt., growing promiscuously, the close similarity of their flowers being curiously contrasted with their diverse foliage; even in the latter case, however, a tendency to assimilate (perhaps due to hybridization) is occasionally observed, in which the sharply hastate leaves of the latter species are irregularly gashed to resemble forms of the other. Besides these everywhere obtrusive forms, we may also note as characteristic of this district *Geranium Fremontii* Torr., *Arenaria congesta* Nutt., *Arenaria Hookeri* Nutt., *Astragalus campestris* Gray, *Oxy-*

*tropis campestris* L., *Lupinus sericeus* Pursh, *Hedysarum Mackenzii* Rich., *Eriogonum flavum* Nutt., and *Calochortus Gunnisoni* Watson. On all the high rocky ridges of this section a charming variety of *Phlox Douglasii* Hook. is met with, forming close, flattened cushions, and a profusion of pure porcelain-white fragrant flowers.

Along the borders of streams, with the prevalent willow growth, we find *Betula occidentalis* Hook., *Alnus incana* Willd., and in the larger valleys *Elæagnus argenteus* Nutt.

On the steeper mountain slopes, before alluded to as presenting an agreeable alternation of meadow and woodland, the smooth grassy expanses of the higher elevations, reaching an altitude of nine thousand feet above the sea level, reveal a distinctly subalpine vegetation. We accordingly here encounter such well known forms as *Saxifraga nivalis* L., *Eritrichium aretioides* DC., *Polemonium confertum* Gray, *Lloydia serotina* Reich., while apparently more distinctly characteristic of this particular range we note *Townsendia spathulata* Nutt., *Townsendia scapigera* D. C. Eaton and *Bupleurum ranunculoides* L.

In the wooded districts *Pinus flexilis* is irregularly mingled with *Pinus ponderosa* and *Abies Douglasii*, while *Pinus contorta* forms the almost exclusive growth of the interior ridges and alpine valleys. After passing the first series of steep ridges, which generally present an abrupt escarpment towards the main axis of the range, the interior valleys are spread out in the form of irregular basins, bordered by deep pine woods. Within these timbered recesses we occasionally encounter small grassy parks, or alpine bogs occupied by a close, clumpy growth of willows. Through these, course clear mountain streams generally hidden from view by overhanging vegetation. During the season of melting snow in the early summer months, these meadows frequently conceal treacherous bogs greatly impeding travel, while small ponds and occasional permanent lakes are not infrequent. In this variety of surface exposure, limited in every direction by irregular, rocky ridges, variously set off with extensive snow drifts, we have all the conditions of a most attractive mountain flora.

We accordingly find here in somewhat confused association the following plants:—*Draba Alpina* L., *Lupinus cæspitosus* Nutt., *Hedysarum boreale* Nutt., *Astragulus Alpinus* L., *Oxytropis campestris* L., *Oxytropis viscida* Nutt.? (or a species near it), *Sedum stenopetalum* Ph., *Sedum rhodanthum* Gray, *Actinella grandiflora*

T. & G., *Antennaria dioica* L., *Senecio lugens* Rich., *Kalmia glauca* L., *Synthyris plantaginea* Benth., *Mertensia paniculata* Dougl., *Gilia nudicaulis* Gray, *Androsace septentrionalis* L., *Primula Parryi* Gray, *Gentiana humilis* Stev., *Phacelia sericea* Gray.

In succeeding articles the flora of the Owl Creek range and of the high mountain district between the Big-Horn and Yellowstone basins will be noticed.

## ANIMAL LIFE OF THE CUYAMACA MOUNTAINS.

BY DR. J. G. COOPER.

When collecting at San Diego Bay in the spring of 1862, I much regretted that the severe floods of that noted season so broke up the roads into the mountains, that I could not get up to them with the necessary materials for making a full collection of the animals and plants. I then supposed that the greater moisture and large forests of the mountains would favor the existence of numerous species as yet uncollected within the Union, if not entirely new. I was disappointed in not finding more of them near the coast, and attributed their absence to the barrenness of the country, and want of trees, essential to many species. I supposed also that some of the Mexican or Lower Californian species said to be found near the boundary must exist there.

My late trip through the mountains, has, however, satisfied me that the animals, like the plants, are comparatively few in species, and mostly of northern forms. It is possible that, somewhat later, stragglers from Lower California might appear among birds and insects, but I was then so near the end of the spring migration, in this latitude, that no common visitors are likely to have escaped notice. As to the non-migratory animals, they have evidently been rendered very scarce by the want of water over most of the range, even in early spring and in an average rainy year like the past. Those that drink could find water in the fall only at intervals of ten to twenty miles, where they must fall an easy prey to the Indians who live at these localities.

The birds, reptiles, insects and mollusca, are however less dependent on a water supply than mammals, as the former can obtain

enough from rain and fogs, while the lower classes frequently remain torpid during unusual droughts.*

The mammals seen were very few. The grizzly bear (or perhaps a different species called the cinnamon bear) is said to occur rarely. The skunks, the most frequently noticed of the small carnivora, did not make their presence known, and I heard ten years ago, that the dry seasons preceding had nearly exterminated them in the low country. The other small carnivora are still more scarce, their usual prey, the Rodentia, having disappeared.

Wild cats are not rare about the highest peaks, and a skin I saw was only a young of the common *Lynx rufus*, var. *maculatus*. I heard formerly of long-tailed spotted cats being found in these southern ranges, but if the *Felis eyra* or *Felis onza* have ever reached them by crossing the deserts eastward, they have become now exceedingly scarce, through starvation or from being hunted. Cayotés (*Canis latrans*) are scarce, and I heard nothing of foxes.

Of Rodents, the almost universal *Spermophilus Beecheyi* was so scarce in the mountains, that I saw only two, both near streams at four thousand feet altitude. They are, however, common near river-beds along the coast, though less so than formerly. I saw a small spermophile near Julian which may have been *S. lateralis*, or a new species, obtained by me at Fort Mojave.

The largest of our tree squirrels, found on the San Bernardino range (*Sciurus leporinus*), is absent, as well as all its arboreal allies. I saw none of the numerous and destructive murine burrowers, nor any bats, but a longer residence might furnish these in some spots. Of the Hare family I saw only a few; *Lepus Californicus* in the foot-hills, and *L. Audubonii* once about two thousand feet up.†

Deer, requiring much water, are very scarce, while the mountains are too rough for the antelope, and too much wooded for the mountain sheep, though both of these may occur not far away.

On account of the scarcity of carnivorous animals, certain kinds

* The complete drying up of the streams from this range, at times, is shown by the absence of fish. Trout and sticklebacks are found no nearer than Warner's Pass fifteen miles north of San Felipe at the head of San Luis Rey river.

† The finding of *Lagomys princeps*, the "Little Chief Hare," by Mr. Gabb, on a mountain in Lower California ten thousand feet high and near the boundary line, is a problem in zoology not easily solved, as this animal could not have reached there from the north under the present climatic conditions, since it does not come lower down on the Sierra Nevada in latitude 39° than six thousand feet (see Proceedings of the Academy of Natural Sciences, Philadelphia, 1868).

of small and prolific species become very abundant after one or two rainy years. Hares and rabbits may then be seen by hundreds at a time, and the California quail as well as other resident birds show the same rapid increase in such years, when food is abundant. Two very dry years preceded this, and consequently all these animals had become quite scarce.*

BIRDS.—Of these I give a list, with such notes as seem requisite. [Those marked † were not found by me in the lower country from January to May, 1862.] Turkey buzzard (*Cathartes aura*), chiefly seen near base of mountains; prairie falcon (*F. polyagrus*), seen once or twice; sparrow hawk (*Tinnunculus sparverius*), quite common; sharp-shinned hawk (*Accipiter fuscus*), not rare; brown hawk (*Buteo insignatus*), very common from the base to the mines, 4,500 feet altitude, and always prized, but I did not find any nests nor shoot a specimen. It seems to be the form most characteristic of this region, though the western red-tail (*B. montanus*) is also common. None of *B. Swainsonii* seen. Squirrel hawk (*Archibuteo ferrugineus*) chiefly near the open plains; marsh hawk (*Circus Hudsonius*), at almost every meadow or low plain.

† Golden eagle (*Aquila Canadensis*), seen rarely; great horned owl (*Bubo Virginianus*), seen or heard on all parts of the route where any trees exist; burrowing owl (*Athene cunicularia*), not found much above the foot-hills.

† Harris' woodpecker (*Picus Harrisii*), a common species in the forests high up; California woodpecker (*Melanerpes formicivorus*), very common, probably up to the highest summits, but not down to the mesa, chiefly in the oaks.

† Lewis' woodpecker (*M. torquatus*), not uncommon in the higher mountains; red shafted flicker (*Colaptes Mexicanus*), abundant almost everywhere; rufous humming-bird (*Selasphorus rufus*), observed April 28th, at 3,800 feet altitude, where they probably breed. Anna humming-bird (*Calypte Anna*), quite common along the route. There were perhaps other species but I did not identify them.

† Oregon swift (*Chætura Vauxii*) seen at the old mission, migrating northward, April 26th, and may perhaps summer in the mountains. [The rare white-throated swift (*Panyptila melanoleuca*) breeds in the Santa Anna mountains, fifty miles north, and perhaps in these.]

† Poor Will (*Antrostomus Nuttallii*), heard at Cajon valley. I both heard and saw these birds near San Francisco as early as March 20th. Arkansas and Cassin's kingbirds (*Tyrannus verticalis* and *T. vociferans*), the last only near the foot-hills, or below. Ash-throated flycatcher (*Myiarchus Mexicanus*), not rare up to 4,000 feet altitude; black pewee (*Sayornis nigricans*), chiefly about the foot-hills.

† Little flycatcher (*Empidonax pusillus*), and probably other species migrating, but not numerous up to 4,500 feet altitude; dwarf thrush (*Turdus nanus*), common in thickets; robin (*T. migratorius*), common near the high forests and no doubt resident; western bluebird (*Sialia Mexicana*), abundant throughout the forests; yellow-throat (*Geothlypis trichas*), common about moist thickets.

† Macgillivray's warbler (*G. Macgillivrayi*), not so common, and in drier localities; orange-crowned warbler (*Helminthophaga celata*), abundant in the lower parts.

† Western warbler (*Dendræca occidentalis*), very common between 1,500 and 4,500 feet altitude, and probably remains all summer. This is the first time I have seen this species common, and it seems to be rare elsewhere, though found in May at the Columbia river, and as early as April 1st, at Petaluma, California, latitude 38°. Large numbers of this and the next four species were seen in the oak forests on both slopes, and though still gregarious were singing a little, and doubtless build there. The others were Townsend's, the gray, Audubon's and the summer warblers (*D. Townsendii, nigrescens, Audubonii, æstiva*); Audubon's probably builds only in the highest woods, as it does at 6,000 to 7,000 feet in latitude 39°; black-capped warbler (*Myiodioctes pusillus*),

* Compare the list of animals of the "Southern Coast Slope" in this journal, June, 1869, and Proceedings California Academy Science, v, Feb., 1870.

quite common and up to summits; Louisiana tanager (*Pyranga Ludoviciana*), abundant on higher part of mountains, and down to foot-hills in summer; cliff swallow (*Hirundo lunifrons*), the only kind found everywhere, except on the high parts above 3,500 feet.

† Green swallow (*H. thalassina*), common in the oak groves up to 4,500 feet; martin (*Progne purpurea*), not uncommon; shining flycatcher (*Phænopepla nitens*), seen rarely among mistletoe in foot-hills; Hutton's greenlet (*Vireo Huttoni*), not rare on the lower mountains; little vireo (*V. pusillus*), common in willow thickets along the lower part of rivers. † Solitary vireo (*V. solitarius*), not rare, and resident; mocking bird (*Mimus polyglottus*), not seen above the edges of the mesa. [The mountain mocking bird (*Oreoscoptes montanus*) has been found "near San Diego."] Bow-billed thrush (*Harporhynchus rediviva*), common in the lower region.

† White-throated wren (*Catherpes Mexicanus*), seen and heard only near Cajon valley, among immense granite bowlders. Their cry sounds like shrill ringing laughter. Bewick's wren (*Thryothorus Bewickii*), common in the lower country; wren-titmouse (*Chamæa fasciata*), very common on the shrubby hillsides; slender-billed nuthatch (*Sitta aculeata*), common chiefly on the east slope in pine woods. † California nuthatch (*S. pygmæa*), also common among pines high up; gray titmouse (*Lophophanes inornatus*), not rare throughout the oak forests; mountain titmouse (*Parus montanus?*), very common indeed near the pine forests. It is possible that this may prove a new species, as they looked smaller and differently marked, but I did not succeed in getting any. Other "critical" species may yet be found to represent some of the northern birds here named. Least titmouse (*Psaltriparus minimus*), common at least half-way up mountains; horned lark (*Eremophila cornuta*), abundant on open plains everywhere. I saw fledged young at San Diego, May 3.

† Evening grosbeak (*Hesperiphona vespertina?*), or some similar bird, I saw and heard a few times near the summits of the mountains; lark finch (*Chondestes grammaca*) is common on most open plains up to 3,000 feet altitude; Bell's finch (*Poospiza Belli*) is confined to the low mesa and foot-hills; chipping sparrow (*Spizella socialis*) common on most parts up to 4,000 feet; Heermann's song sparrow (*Melospiza Heermanni*), also common; black-headed grosbeak (*Guiraca melanocephala*), very common in all the woods.

† Blue grosbeak (*Guiraca cærulea*) also quite common up to 4,500 feet. [Going north I saw twenty-five miles north of San Diego, a single Mexican goldfinch (*Chrysomitris Mexicanus*), new to the California fauna.] Blue (or lazuli) finch (*Cyanospiza amœna*), numerous in the foot-hills, up to 3,500 feet; California ground robin (*Pipilo megalonyx*) has about the same range; brown finch (*Pipilo fuscus*) does not go as high up.

† Cow bird (*Molothrus pecoris*) occurred in flocks on the east side of summit only, at 4,500 feet altitude; yellow-headed blackbird (*Xanthocephalus icterocephalus*), with the last, and also on west slopes in marshes; western lark (*Sturnella neglecta*), everywhere in open plains and meadows; Bullock's oriole (*Icterus Bullockii*), common; hooded oriole (*I. cucullatus*), not rare up to 2,000 feet in foot-hills; Brewer's blackbird (*Scolecophagus cyanocephalus*), abundant almost everywhere; raven (*Corvus carnivorus*), in pairs occasionally up to at least 4,500 feet; western crow (*C. caurinus*), common up to about 2,000 feet in oak woods.

† Clarke's crow (*Picicorvus Columbianus?*) probably occurs, as almost always in the yellow pine forests, but at this season is so shy and silent that I am not certain of having seen it.

† Steller's jay (*Cyanura Stelleri*) was not rare in the pine woods. California jay (*Cyanocitta Californica*), confined to the oak woods up to about four thousand feet altitude.

† Band-tailed pigeon (*Columba fasciata*), in small flocks above three thousand feet altitude.

† Mountain quail (*Oreortyx pictus*) is common above three thousand five hundred feet, and were paired by April 28th. I afterwards heard what I think was this bird on a mountain east of Anaheim, Los Angeles Co., at not over one thousand feet elevation, where some small cypress trees grow. A male shot agrees exactly with description

except in size smaller than northward. This is one hundred and twenty miles south of the most southern locality before known.

California quail (*Lophortyx Californicus*), confined to the region below three thousand five hundred feet.

Snowy heron (*Garzetta candidissima*), I saw once at a pond on east side, four thousand five hundred feet. Kildeer (*Ægialitis vociferus*), common about every gravelly stream or pond.

† Stilt (*Himantopus nigricollis*), probably migrating April 30th, when I saw a flock of about twenty at the same locality as last.

† Solitary sandpiper (*Rhyacophilus solitarius*) occurred rarely along wooded streams high in the mountains. Coot (*Fulica Americana*), rare on pools high up in the mountains. Mallard (*Anas boschas*), in small flocks on the ponds and head waters of San Diego river at four thousand five hundred feet altitude, where they no doubt remain all summer.

Thus, of eighty-four species observed, only seventeen are new to the country, and all these are species of much more northern range. Three or four belong rather to the mésas than the mountains, with others not mentioned. During my former six months' residence I found twenty other species of land birds alone, within ten miles of the coast; some, however, only winter visitors there. I saw also twenty-six other waders, and fifty-two swimmers.

REPTILES.— I noticed none above the mésa, perhaps on account of the early season, though it was warm enough up to four thousand feet on our return route. Many little wood-frogs (*Hyla regilla*) were about the high marshes, and I heard what I supposed to be salamanders piping with them at night.

FISHES.— None are known to exist in this range.

MOLLUSCA.— At the cañon of San Diego river is a rich locality for terrestrial species, as I found there the meeting point of the five largest species belonging to the mésa and the mountains, associated in considerable numbers, but difficult to obtain living, as they had mostly retired into deep fissures of the rocks. My rapid journey was not favorable for obtaining many species, but they have been collected by Mr. H. Hemphill, at the mines, also by Mr. Hemphill, Mr. G. W. Dunn and myself near San Diego (in 1862), so that I can give the following lists, comparing the species of the two regions. We saw no trace of the Lower Californian Bulimuli, etc.

| LOWLAND SPECIES. | MOUNTAIN SPECIES. |
|---|---|
| 1. Lysinoe Carpenteri. | 2. Lysinoe Traskii. |
| 3. Arionta? Kellettii. | 4. Arionta tudiculata. |
| 5. Macrocyclis Voyana. | 6. M. Vancouverensis ?H. Newberryana. |
| 7. "Helix" Newberryana (Limax campestris, I found at San Juan R., 50 miles northward, and it very probably occurs nearer to San Diego Bay). | 8. Hyalina arborea. |
| | 9. Conulus chersina. |
| | 10. Pseudohyalina Mazatlanica. |
| | 11. Vallonia minuta. |
| 12. Planorbis subcrenatus. | 13. Succinea Oregonensis. |
| 12. Succinea rusticana. | 15. Lymnophysa humilis. |
| 14. Limnophysa bulimoides. | 17. Physa diaphana. |
| 16. Physa Gabbii. | 19. Pisidium occidentale. |
| 18. Physa humerosa, *var.* virgata. (Not on Mts. ?.) | |

5. For notes on this and others, see Proc. Cal. Acad. v, 171, June, 1871.
7. This inhabits a belt in the foothills not over 500 ft. elevation, and at the upper edge of Mesa.
18. Found about Desert with Helisoma ammon.

2. Young, of 2-3 wh. hirsute.
4. Up to 1,000 ft. elevation.
6. I found this dead only, and think it may be distinct from the far northern species. Only seen in the Canon.

# ON THE RELATIONSHIP BETWEEN DEVELOPMENT AND THE SEXUAL CONDITION IN PLANTS.

BY JOHN STOCKTON-HOUGH, M. D.

INDIAN CORN (*Zea Mays*) is sexually monœcious, that is, the male and female flowers are normally on different parts of the same plant. Occasionally, however, the female flowers appear among the male flowers, on the same raceme, and more rarely, the male flowers appear on the spike (ear) among the female flowers, and still more rarely, they are hermaphroditic.

Other observers reverse the order of rarity of these anomalies and say that "male flowers sometimes appear amongst the female flowers, and Mr. J. Scott has lately observed the rarer case of female flowers on a true male panicle, and likewise hermaphrodite flowers."*

The writer collected and examined nearly a hundred specimens of these anomalies (female flowers among the males), during the last autumn (1872) with a view of determining the relationship between the *proportion* or excess of either *sexual element* and the condition of *development* of the *plants* bearing such anomalous flowers.

The stalks bearing female flowers among the males were almost without exception "*suckers*," that is, branches coming off from the main stalks at the nodes among the adventitious roots just below the surface of the ground. The junction of one of these "suckers" with the stalk on which it is a parasite, so to speak, is greatly constricted, and the point of attachment is scarcely more than an eighth of an inch across. There are few, if any, serviceable adventitious roots to these suckers, so the stalk derives its nourishment wholly from the trunk to which it is joined, and as a consequence such stalks are short, slim and pale in color, having abridged internodes, or in other words, *they are undeveloped.* A wet season, injury to the main stalk, shady locations and the borders of fields, seem to favor their production.

* Darwin, Variations in Animals and Plants under Domestication, out of Trans. of Botan. Soc. of Edinburgh, vol. viii, p. 60.

From what has been brought forward, it would appear as if these sexual anomalies were the result of *deficient nutrition*, from which resulted *defective development* and *restrained evolution* of the sexual organs.

There were many stalks to be found, bearing male flowers ("tassels") alone in the normal position (terminal), apparently perfect males in size and development, but no stalks are to be found bearing a complete spike (ear) of perfect female flowers alone, even when terminal. Such spikes (ears) are always defective, often being but partially filled with grains, even when no male flowers are present.

The spike (ear) is only an undeveloped branch, sometimes having two or three internodes it is true, but it is generally sessile.

When the ear is in the normal position, no matter how much the female flowers may prevail or how defective they are, the male flower always normally appears in the terminal part of the main stem or stalk. Not so with the wholly male plant, which has a tassel in the normal position (terminal) without a sign of a place for a female flower.

When the ear (female spike) abnormally bears male flowers, they are usually terminal on the cob, though sometimes they may be on any other part of the ear, even a single male flower among the closely crowded grains (females). Mr. Scott, as already mentioned, speaks of having found even hermaphrodite flowers, which would naturally appear to be much more rare among diœcious plants than among the monœcious, for the latter condition would appear to stand between the diœcious and the hermaphroditic.

Great numbers of corn plants bear male flowers only, while none are female alone, and wherever they approach the latter condition, the spike (ear) of female flowers is terminal. These exclusively male plants are usually as large as if not indeed larger than the normal kind (monœcious) and are certainly more rank and vigorous in their growth than those plants which bear principally female flowers on the terminal part of the plant, which latter, as I have already said, are much shorter, more slender, and pale in color.

The following table will indicate these differences. Fifty spec-

imens of plants of Indian corn, having an abnormal sexual arrangement of the flowers, had the following proportions:—

| | Exclusively male stalks (dioecious). | Normal stalks, male and female (monœcious). | Stalks having a few female flowers in the male panicle (approaching hermaphroditism). | Stalks having nearly all the flowers female and terminal (nearly dioecious). |
|---|---|---|---|---|
| Average height. | 124 in. | 118 inches. | 88 inches. | 46 inches. |
| Terminal internodes. | 7–11 in. | 6–10 " | 4–6 " | ½–2½ " |

From this showing it appears that in proportion to the participation or predominance of the female element, just in that proportion does the plant decline in size and development, and we are forced to conclude, as we have shown in several other articles,* that *females are undeveloped males*, and this is true in plants as well as among animals.

In some cases where the female flowers were on the male panicle, instead of forming a single large ear, as was usually the case, each branch of the panicle bore grains separately, which must have resembled what Bonafous mentions as a variety called Cymosa, which has its ears so crowded together that it is often called *maïs à bouquet*. Some of the specimens examined by me had the appearance as if the cob had been separated into several segments, triangular in shape, bearing corn only on one side (the outer) of the triangle.

Returning to those stalks bearing male flowers alone and which, I have said, are tallest, most rank, and best developed,—I would suggest that the absence of female flowers was due to retarded fe-

*Longevity and other biostatic peculiarities of the Jewish race. N. Y. Medical Record, May 15, 1873. pp. 241, 2, 3, 4. The Relative Viability of the Sexes, etc. N. Y. Medical Record, June 16 and July 15, 1873. pp. 9. The Laws of Transmission of Resemblance from Parents to their Children. N. Y. Medical Record, Aug. 15, Sept. 15, Oct. 15, and Nov. 15, 1873. pp. 16. Statistics Relating to Births, Marriages and Deaths, and Movement of Population in Philadelphia, for the eleven years ending 1871. Penn. Monthly, Sept., 1873. pp. 24. Papers of the Social Sci. Assoc. of Philadelphia, 1873. The Physical Aspects of Primogeniture. N. Y. Medical Record, Jan. 15, and Feb. 15, 1874. The Temperature of the Sexes, an Indication of Development. Phil. Times. Nov. 8th, 1873. pp. iii. Nativity of Parents, as Influencing the Fecundity and Proportion of Sexes in births in general, and in twin, illegitimate, and still-births in particular. Phil. Med. Times, 1873. A new Theory as to the Cause of Enlargement of the Prostate Gland, etc. The Proximate Cause of Evolution.

An Inaugural Dissertation [presented to the Trustees and Faculty of the University of Pennsylvania, March 13, 1868, for the Degree of Doctor of Medicine], entitled; Prepotency, Sexual Elective Affinity, Non-congeniality, or the *dynamic differentiation* of the Elements of Reproduction in the Human Species; the cause of Relative Sterility; By John Stockton-Hough, A. M., M. Chem., of New Jersey; The Cause of Rotation and a nearly equal number of Sexes in Births."

cundation of the ovules from which such stalks were produced. This point might be practically tested by planting a single stalk in a field far removed from any other corn. The tassel should be cut off as often as required to prevent the male flowers from forming, then the pollen from another plant should be applied to the female flower at the latest moment when fecundation is possible. By this method we should expect to get the largest possible proportion of exclusively male-generating grains. To get the largest possible proportion of female-producing grains, the female flower should be fecundated at the earliest possible moment—earlier than nature does it. The grains produced under these circumstances would, when planted, give the largest and the smallest proportion of exclusively male or female plants.

It would be well to determine whether the grains near the tip, in the middle, or near the base of the ear, gave the largest proportion of exclusively male-producing grains. The following will illustrate how the facts might be tabulated:—

| Grains. | Number of stalks no ear. | Stalks one ear. | Stalks two ears. | Whole number of ears. | Whole number of stalks. | Average number of ears to each stalk. |
|---|---|---|---|---|---|---|
| From tip | X | P | V | P+2V | X+P+V | $\frac{P+2V}{X+P+V}$ |
| From middle | Y | T | W | T+2W | Y+T+W | $\frac{T+2W}{Y+T+W}$ |
| From base | Z | N | O | N+2O | Z+N+O | $\frac{N+2O}{Z+N+O}$ |

Metzger* has observed that the effect of climate on Indian corn, as cultivated in Germany, causes "the lower seeds in the ear to keep to their proper form, but the upper seeds become slightly changed."

"Among species of Carex, it is a common thing for the spike to consist of male flowers at the top, and female flowers at the base; though the converse is much more common."† Dickson, Mohl, Schleiden, Braun, Cranmer and others have observed cones of different species of pines, usually female, having male flowers in the lower part of the cone.

M. Charles Girou de Buzareignues‡ has made many observa-

*Getreidearten, s. 206.

†Annales des Sciences Naturelles, t. xvi, p. 140, extracted from his De la Génération, 8vo, Paris, 1828.

‡Maxwell Masters; Vegetable Teratology, Ray Soc., London, 1869. 8vo, pp. 191 (Heterogamy); compare Hopkins' General View of the Anomalies in the Vegetable Kingdom, Glasgow, 1817, also, Moquin-Tandon; Éléments de Teratologie Végétal, 1841, p. 126, *et al.*

tions on the proportion of male and female plants produced from seeds taken from different parts of the hemp plant. He found that the seed taken from the lower, more mature, and more highly developed parts of the plant gave a much larger proportion of male-producing seed, than seed taken from the upper, more succulent, less mature, less highly developed parts, as the following figures will indicate. Of 125 hemp plants the proportion of males to females was—

| | Males | Females |
|---|---|---|
| 1° In the subjects taken from the weak plants,..... | 692 | 1000 |
| In those which came from strong plants,..... | 907 | 1000 |
| 2° In the subjects taken from the seeds furnished by the *inferior half* of the stem of weak plants,..... | 1250 | 1000 |
| And in those which came from the *superior half*..... | 444 | 1000 |
| 3° In the subjects taken from the seed furnished by the *inferior half* of the stem of strong plants,..... | 1000 | 1000 |
| And in those which came from the *superior half*,..... | 827 | 1000 |

The same observer in subsequent experiments* declares that seeds from nearest the summit of the stem gave proportionally more females than those from the middle and base. The lower branches gave a larger proportion of males than the upper. I might repeat many similar experiments with the same result.

Concerning the size of the seeds, he says that the largest and smallest gave a predominating proportion of males, while those of the mean size gave more especially females.

The carefully made observations of Mr. Thomas Meehan of Germantown, Philadelphia Co., Penn., are singularly in harmony with those of Mr. Girou and others, though, I believe, made entirely independently of a knowledge of the latter.

Mr. Meehan† has observed that in several plants of the order Cupuliferæ, and he believes in all of them, "we find the female flowers only on the strongest young growths, and only at or near the apex of the first great wave of spring growth, as if it were the culmination of a great vegetative effort which produced them, instead of a decline as in the male."

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*Girou, Suite des Expériences sur la Génération des Plantes, Annales des Sciences Naturelles, t. xxiv, pp. 138–148.

†On the Sexes of the Plants. Proc. Amer. Assoc. Adv. Sci., 1869, pp. 256–60. See also, *ibid.*, 1870, pp. 276–280; *ibid.*, 1868, p. 317. Proc. Acad. Nat. Sci., 1868, 9, 70. Also Gardener's Monthly (edited by Mr. Meehan), 1870, p. 333, *et al. temp.* Also Dr. S. W. Butler's Review (editorial) of Mr. Meehan's observations and deductions, Medical and Surgical Reporter, Phila., Oct. 22, 1870, p. 330, *et al. loc. Op. cit.*; also, Mr. Meehan in Old and New, Feb., 1872, p. 173 *et seq.*

In the case of Norway spruces it is "only in the fourth or fifth year, when vitality in the spur is nearly exhausted, do male flowers abundantly appear."

Mr. David Moore, in his morphology of Nepenthes,* says that "vigor and healthiness increase the female line of vital force in vegetables, while weakness is more conducive to the male development." When growth has ceased, maturity and complete development are accomplished, and the business of reproduction exclusively occupies the plant.

From all this it appears then, that while the plant is mostly occupied in vigorous growth, while it is yet succulent, *immature*, or is, in other words, *undeveloped*, does it bear the largest proportion or principally female flowers. As growth is antagonistic to development, and it is only after perfect development is reached that the reproductive function is most active, we are forced to conclude that the production of male flowers or fruit is a higher effort of the plant than the production of females.

I have ventured to enunciate it as a law† deduced from a thorough study of the subject, that the greater the fecundity, in single births, the larger the proportion of male children, and *vice versa*. I have also said that the begetting of males is a higher role in the reproductive act of the mother than the begetting of females; while the begetting of females on the part of the father is a higher reproductive role than the begetting of males.‡ In this article it has been shown that the greater the "*vigor*" (rapidity of growth and excessive vital and vegetative action) the larger the proportion of females produced. Now, it is so well known and so universally recognized and pointed out by physiologists, that this same *vigor is directly antagonistic to reproduction*, that it is scarcely necessary for me to mention it. Hence females are begotten when the system is more occupied by the process of growth, reparation or disease, than when males are begotten.

Dr. Henry Hartshorne§ has maintained Mr. Meehan's view of the relation of vigor to sex. To the facts stated I fully agree,

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*Trans. of the Royal Irish Acad., Vol. xxiv. p. 629, 1870.

†The Relative Viability of the Sexes, etc. N. Y. Medical Record, June 16, and July 15, 1873, p. 301; and Statistics of Philadelphia, Proc. Social Sci. Assoc., 1873, p. 18.

‡See farther, in the author's thesis, already alluded to, in foot-note; also his paper on Laws of Transmission, etc., etc.

§On the Relation between Vigor and Sex. Proc. Amer. Assoc. Adv. Sci., 1872, pp. 192–7.

but the deductions which they have both arrived at, viz.: that the begetting of female offspring is a higher role on the part of the mother than the begetting of males, — that is, requires a more perfect developmental effort — and as a consequence, females are more highly developed than males, are diametrically opposed to my own conclusions, as may be seen in this and in the other papers referred to.

The use of the word "vigor" is scarcely scientific; it has only a practical, conventional meaning, and should be studiously avoided by scientific biologists, as it is almost useless by way of comparison. Development is the proper physiological expression, and indicates the degree of evolution or maturity of the various organs of the animal or plant, and we can readily compare the different stages and degrees of development exhibited in each organ. Mr. Meehan studiously avoids the use of this last named word, and would, I am persuaded, alter his deductions if he should weigh its full meaning, and apply it in his comparisons. He cannot, however, be too highly praised for his excellent series of observations already alluded to.

With a view of showing the fallacy of the use of this word vigor, I may state that Dr. Gouverneur Emerson of Philadelphia, several years ago, discovered that "the extensive prevalence of every severe zymotic epidemic, or endemic disease; every occurrence, in fact, which exerts, either directly or indirectly, a decided, depressing effect upon a community, will be indicated in the record of births by a conspicuous reduction in the proportion of males."* He bases this opinion upon the careful study of the statistics of births in Philadelphia during the prevalence of cholera in the year 1833; also for Paris 1832. In the first named city, the percentage of excess of male births for the decade from 1830 to 1840 was 6·29, while "the diminution of male conceptions, during the cholera, was at the rate of 17 per cent." The number of conceptions during the months in which cholera prevailed was 1826 males and 1851 females, or 98·64 males to 100 females. In Paris, in 1832, the year cholera prevailed there, the excess of male conceptions was reduced from the usual average of 6 per cent. to $3\frac{1}{2}$ per cent. From this we see that a "*lessened vigor*," so to speak, is accompanied by an increase in the proportion of female births; so

*Causes operative in determining the Proportions of the Sexes at Birth. American Journal of the Medical Sciences, July, 1848, pp. 78–85.

a lessened or increased vigor may determine this increased tendency toward the production of females ; in fact, anything which operates upon the animal economy by distracting it from the business of reproduction, such as rapid and vigorous growth, developmental processes, mental anxiety, or incipient disease, will cause a lessened fecundity and an increase in the proportion of female offspring.

Mrs. Mary Treat* of Vineland, N. J., has, by repeated experiments on butterflies, found that by overfeeding a certain number, a large proportion of female eggs was produced, and that by underfeeding, or partly starving them, the proportion of male eggs was increased.

The writer has shown in his paper on "The Nationality of Parents as Affecting the Fecundity and the Proportion of Sexes in Births"† that foreign mothers (who are unquestionably more "vigorous" than native mothers) have a much larger proportion of boys among their children.

Mr. H. H. Howorth, in his paper entitled "Strictures on Darwinism,"‡ says that he "cannot but conclude that sterility is induced by vigorous health and by a plentiful supply of the necessaries of life, while fertility is induced by want and debility, and that this law acts directly against Mr. Darwin's theory, in that it is constantly recruiting the weak and the decrepit at the expense of the hearty and vigorous, and is constantly working against the favorite scheme of Mr. Darwin, that in the struggle for existence the weak are always being eliminated by the strong."

It will be seen by the above that the views of Mr. Darwin and Mr. Howorth are both extreme; the former believing that the greatest fecundity and best products belong to the most vigorous, while the latter believes that the most feeble are most prolific, and have the most vigorous offspring.

The writer is of the opinion, from a careful study of the subject, that a medium condition between these two extremes is most favorable to fecundity and the production of healthy, vigorous offspring, namely, developmental maturity of the parents, and a moderate supply of food in connection with a life most in accordance with nature.

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*AMERICAN NATURALIST, March, 1873, Laws Controlling the Sexes in Butterflies.

†Philadelphia Medical Times, . . . . 1873.

‡Journal of the Anthropological Institute. London, April, 1872, pp. 21–40. p. 37. Part 1, Fertility and Sterility.

We have seen, then, that excessive "vigor" increases the proportion of females; lessened "vigor" decreases the proportion of males (apparently increases the proportion of females); and that greater "vigor" increases the proportion of males:—from all of which we conclude that there is *no constant "relationship between 'vigor' and sex."*

In my paper on the "Relative Viability of the Sexes, etc.," in which I have shown that females have a higher viability (greater longevity) than males, I ventured to ascribe this greater viability to the fact of female fetuses sapping the vitality of the mother more than males. However this be, there can be no doubt of the facts stated, for Prof. Martegoute* in his observations on the breeding of the Dishley Mauchamp merino sheep, says,—"Our monthly weighings show that the ewes that have produced female lambs are on an average of weight superior to those that produced the males; and they evidently lose more in weight than these last, during the suckling period; while the ewes that produce males, weigh less, and do not lose in nursing so much as the others."† "That is, mothers are in better condition when they *conceive* females, and are in better condition when they wean males than females." Dr. Congar‡ has observed the same thing concerning women. Dr. Spruce,§ a South American traveller, noticed that a certain palm (Geonoma) bore fruit (female flowers) one year, and male flowers the next, alternating from male to female from year to year. This same fact is seen in some animals, that bear females for several generations, then males; in fact the process of "alternation of generations" is dependent upon this principle, of which I shall have more to say in another paper.‖

I have stated that some stalks bore only male flowers, and suggested that this fact was the result of retarded fecundation of the ovule from which the stalk was produced, and I may now point out how nature allows these peculiarities to be produced.

It has been observed, says Lindley,¶ that the quantity and kind of light to which the plant is subjected determine the sex of the

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* Journal d'Agriculture Pratique, etc.
† Goodale, Breeding, etc. of Domestic Animals. Boston, 1861, pp. 91, 92.
‡ H. M. Congar, M. D., Buffalo Medical and Surgical Journal, August, 1867.
§ Criticism on Dr. Spruce's article, by Dr. Wendland, in Botan. Zeitung, 1869.
‖ The Cause of Rotation and nearly Equal Number of Sexes in Births.
¶ Theory of Horticulture, N. Y., 1852.

future products of the seeds produced under these circumstances. General Pleasonton* of this city has lately determined that both animals and plants thrive better under a violet colored light, which is in harmony with the experiments of Dr. Daubeny.† Mr. Thomas Andrew Knight‡ observed that the relative quantity of light and heat determined the sex of the flowers produced by certain plants. Lindley says, "It will be found that no pollen is scattered in damp, cold weather, but in a sunny, warm, dry morning the atmosphere surrounding such plants, is, in the impregnating season, filled with grains of pollen discharged by the anthers. In wet springs the crops of fruit fail, because the anthers are not sufficiently dried to shrivel and discharge their contents, which remain locked up in the anther cell till the power of impregnation is lost."

Gaertner§ has pointed out in his "Notice sur des Expériences concernant la Fécondation de quelques Végétaux," the decided influence of the state of the atmosphere on the process of fecundation. He insists on the maturity of the pollen as essential to the process. During a warm time the stamens of the rue accomplish their movements in two or three days, whilst they are, by a cold air and an advanced season, scarcely terminated in eight days. Fecundation requires also a greater quantity of pollen in the last case than in the other.‖

This being the case, we can readily understand that a few wet days may prevent the pollen from being disseminated, while the ovules continue developing, and fecundation is retarded from this cause, and it is for this reason that the production of a larger proportion of exclusively male-producing grains is due.

Darwin¶ says that "walnut trees, which are properly monœcious, sometimes entirely fail to produce male flowers;" and "the female silver maple will not unfrequently put forth branches of male flowers."

Some cultivator has recorded** a series of experiments on

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*Pamphlet, Phila., 186–.

†Lindley, p. 172, out of Dr. Daubeny, Phil. Trans., 1836, p. 149.

‡Selections from Mr. Knight's Physiological Papers, pp. 347-357, out of the Phil. Trans.

§Naturwissenschaftliche Abhandlungen, Tubingen, 1826. t. 1. . . .

‖Koelreuter. Vorlaenfige Nachricht von Einingen das Geschlecht der Pflanzen betreffenden Versuchen, pp. 10, 19, from Gardener's Chronicle, 1847, pp. 541-558.

¶Animals and Plants under Domestication.

**American Agriculturist, N. Y., Orange Judd, M. A., Editor.

Indian corn, with a view of obtaining the largest proportion of stalks bearing two ears. The following was the method employed; all the stalks bearing but one ear had the "tassel" (male flower) cut off before it was full blown, so that all stalks bearing two ears would be surely fecundated by the male flowers of the same or other stalks also bearing two ears, thus securing duplicity on both the male and female sides. In this way, we are told that the proportion of stalks bearing two or more ears, was increased to a considerable extent, by the planting of grains procured by this process.*

A single ovule may be fecundated by the pollen of at least two different varieties, as may be seen from Mr. Arnold's experiments given below†.

From what we have shown, it would appear that the grains near the base of the ear are less variable and more mature than those near the tip, and are consequently more desirable for seed, as they would be likely to give plants more vigorous and prolific.

I may state here that it is the habit of good farmers to select the largest and fairest ears, containing the largest, fullest, and hardest grains, for seed; and that a popular notion prevails that ears having a few remaining glumes of abnormally placed male flowers at the tip of the cob are called "female ears" and are supposed to be more prolific, at least are thought to be more desirable for "seed"; whether there be any foundation for this belief I am not informed, but am inclined to look upon it as a "vulgar error."

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*From James Logan's experiments it would appear as if it were the rule, under ordinary circumstances, for the female flowers of plants in the same hill to be fertilized principally by the pollen from male flowers in the same hill.—Experimenta et Melemetemata de Plantarum Generatione, auctore Jacobo Logan, Leyden, 1739. Translated into English by J. F., and published with original Latin text, opposite page. London, 1747. 8vo. pp. 32. p. 9.

†Mr. Arnold of Paris, Canada, has shown that if the female flowers of an Indian corn plant are submitted to the action of pollen from male flowers of different kinds of corn-plants, each grain of the ear produced shows the effect of both kinds of pollen. In an experiment related, a given female flower was subjected first to the action of pollen from a yellow variety of corn, and then to that taken from a white variety; the result was an ear of corn each grain of which was yellow below and white above. The conclusion presented is, not only that there is an immediate influence on the seed and the whole fruit structure by the application of strange pollen, but the more important fact that one ovule can be affected by the pollen of two distinct parents, and this, too, after some time had elapsed between the first and second impregnation. [From the author's paper on The Laws of Transmission of Resemblance from Parents to their Children. New York Medical Record, 15th of Aug., Sept., Oct., and Nov., 1873, pp. 16—out of Scribner's Monthly, Sept., 1873.]

Columella* and Celsus†, in ancient times laid great stress upon the selection of seed-corn; and Virgil‡ says—

> "I've seen the largest seeds, tho' view'd with care,
> Degenerate unless th' industrious hand
> Did yearly cull the largest." §

To recapitulate then,—the conclusions arrived at in this paper are:—

1. That in plants, and animals as well, that are actively occupied in vegetative, physiological, pathological or other efforts which are antagonistic or complementary to the office of reproduction, the proportion of females borne during such times is greater than where the plant or animal has reached full developmental maturity‖ and growth, is in good health, and is occupied principally in the process of reproduction. In this latter condition offspring of a higher developmental condition are produced, and the proportion of males is increased.

2. Females are in better condition (that is, they are fatter, more active in growth), more troubled by disease,¶ or other process antagonistic to reproduction where they conceive with females than with males; and they are made poorer, become more exhausted, and less healthy, by the production of female offspring than by male products.

4. It is just possible that the ovules from which females are derived may have a higher initial vitality (vigor) though they be less highly developed than those from which males are derived, yet no egg can properly be said to be predestined *to be* male or female.

5. That female plants like female animals are less highly developed than males, and are the result of an inferior developmental reproductive effort on the part of the female parents.

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*De Re Rustica.

†Darwin; Animals and plants under Domestication, vol. ii. p. 303.

‡Georgics.

§Darwin, *op. cit.*, vol.i, p. 319.

‖See farther in the author's paper on The Physical Aspects of Primogeniture; or the Relative Viability of Offspring of Different Pregnancies.—New York Medical Record, January 15 and February 15, 1874.

¶Dr. Gouverneur Emerson was the first to point out the effect of a prevailing epidemic (cholera) in reducing the proportion of male births. See his proof in his paper in the American Journal of Medical Sciences, July, 1848, pp. 78-85.

# RAMBLES OF A BOTANIST IN WYOMING TERRITORY.

BY REV. E. L. GREENE.

## I.

SITUATED in the midst of a wide waste of treeless and even shrubless plains, which are at an elevation of a mile and more above the level of the sea, the city of Cheyenne would scarcely be thought a central point from which one might make many interesting little botanical excursions. The strong northwest winds, which prevail here almost incessantly, by day and by night during all the winter months, seem to sweep all the snows into the valley of the La Poudre, in northern Colorado, and leave the plains of Wyoming quite bare; so that one sees here only the short dry curly turf of buffalo and grama grasses, here and there interspersed with the spiny balls of *Echinocactus Simpsonii*. More than once during the winter of 1871–2, on the calmer, better days that are incident to even a Wyoming winter, did the writer of these notes stroll forth upon those plains, to ask of the sere grasses and withered cacti, what else could possibly grow among them in the summer.

Our first spring visit to this region was made on the twentieth of May. The grasses were beginning to show green, the little spherical *Echinocacti* were crowned each with its chaplet of rose-purple flowers, and the low matted *Phlox Douglasii* was blooming almost everywhere. A few rods from the depot of the U. P. Railway we stood upon the ridge of bluffs that overlook the turbid stream called Crow Creek, and its now beautiful little valley. The pebble beds that lie along the shore of this almost alpine river are quite gorgeous with purple and yellow. The yellow we recognize as the handsome bloom of *Thermopsis fabacea*, a common plant of this region, bearing heavy racemes of lupine-like flowers, but the purple is apparently something more interesting. It is a low growing plant, so small that although we are but a few rods from where it is, and we are looking almost straight down upon a large, dense patch of it, we cannot determine it. The color is much like that of several of our beautiful Coloradian *Astragali*,

but it is not their habit to grow so thickly as to color the whole face of several acres, for taking a glance up and down the stream we behold the gravel beds everywhere purple with the same abundance of bloom. After waiting just a moment in order to enjoy the pure delight of a happy anticipation, we hasten down the steep bluff side, and find ourselves scarcely able to believe what our eyes tell us. Is it possible that *all this* is Nuttall's *Oxytropis multiceps*, one of the most rare and charming of all the plants that are peculiar to the Rocky Mountains? A plant hitherto rarely met with at all, and only on a few alpine summits in Colorado and Montana. The year before, we had taken a few depauperate specimens, in seed only, on one of the Colorado Mountains, and had prized even those poor ones very highly. It grew like a poor little half-starved stranger where we found it then; but here it is luxuriant and plentiful, and this Wyoming region is doubtless its proper home. Passing up to the bluffs of the other side, a half-mile or so away, we find two or three other very interesting little leguminous plants, *Astragalus sericoleucus*, a silky-white, spreading vetchling with purple flowers, and also the more rare *Astragalus cæspitosus*, the latter scarcely yet in full flower; and finally another, with silky-white foliage, and most splendid racemes of purple. Of this plant we found but one root, out of which we made half a dozen herbarium specimens, but it proves to be Nuttall's *O. Lagopus*. It was thought to be a species yet undescribed; Dr. C. C. Parry has this season found the same farther northward, and has collected fruit as well as flowers. All our Rocky Mountain species of this genus are beautiful, and this rare one is among the finest.

But the middle of May is rather too early in the season to find a great variety of flowers at this high altitude. We must wait about another four weeks, if we are to see these plains in all their glory.

It is now the 20th of June, and we are ascending the grade of the Denver Pacific Railway from the lower plains of Colorado, to the high lands of Wyoming. We pass the boundary line between the two territories, just as the highest point is reached. It is now about noonday, and we are but ten miles from Cheyenne. There is plenty of time for a botanist to reach the city before night, and so we beg of our conductor the privilege of making the remainder of the journey on foot; for these bluffs and table-lands are now

gorgeous with flowers of many colors, and we are impatient to see what they are. The whistle sounds, and the train slackens speed, until the leap may be made with safety, and we alight. The train moves on and soon passes from our sight, and we are alone but for the distant companionship of a beautiful herd of antelope which graze upon a near hill-side, a jack-rabbit, and a colony of prairie dogs. But we were landed just on the south side of a line of snow fence, where the snows drifted deep last winter, and so moistened the ground that the flowers and grasses of June are here to be found in greatest luxuriance. Let us see what we have. Very conspicuous are some yellow heads of a composite, borne upon tall and slender scapes, and waving with the grasses in the wind. At the base of each stem is a rosette of narrow, somewhat silky leaves, and the plant is *Actinella scaposa* Nutt.

In the winter season, on the hill-tops near Cheyenne, we had noticed some close tufts of mossy-green, sharp-pointed leaves, and here we find the very plant in bloom. It has sent up numerous branching stems, two inches or more in height, bearing rather large, sandwort-like flowers. It proves to be *Arenaria Hookeri* Nutt., a rare species as well as a handsome one. The truly elegant little *Astragalus cæspitosus*, which a month ago was barely beginning to show bloom, is not yet gone by, and here we gather lovely specimens of it with the rest, and then pass on over and between various hills and bluffs, and out upon the clear green expanse of plains, toward the metropolis of Wyoming.

Now we are in the midst of a dense patch of wild peas, of a low growth, hairy leaves, and very large purple flowers; a form of *Lathyrus polymorphus* Nutt.; and a plant scarcely inferior in beauty to the best of the cultivated species of this genus.

Yonder is a slight depression in the surface of the plain, where there was more moisture in early spring. The whole spot of ground is colored dark dull red, not with flowers, but with the large showy fruits of *Rumex venosus* Pursh. Two species of Pentstemon are especially attractive among the flowers of this region; *P. cristatus* Nutt., with very large pale purple flowers, in a short rather one-sided raceme, and *P. albidus*, with smaller and almost white corollas, arranged in a long raceme. The latter species is abundant, almost whitening long lines of ridges. A very fine perennial lupine, whose specific name I cannot venture to give, with blue and black flowers borne in large dense spikes, is very noticeable on the stony

hill-sides; and again in the valleys, or gentle depressions between the rolling hills, are the rich purple tufts of *Astragalus bisulcatus* Gray. This is a very handsome perennial, and would be desirable enough for cultivation, but for its disgustingly strong odor of bean-vines.

Besides these more noticeable things, our ten miles walk added to our herbal several very interesting rarities, which would have been overlooked by one who had sought only the showy and beautiful things of this interesting ground. A remarkable profusion of very handsome flowers, of a few species only, is what especially characterizes the flora of this region at this season of the year. Passing through it by rail, one sees as much of the purple and red and white and yellow of the plants mentioned, as of the common verdure of the prairie grasses.

## THE PRESENT ASPECTS OF BIOLOGY AND THE METHOD OF BIOLOGICAL STUDY.*

BY PROFESSOR ALLMAN.

*Conception of Biology and Function of the Scientific Method.*—Under the head of Biology are included all those departments of scientific research which have as their object the investigation of the living beings—the plants and the animals—which tenant the surface of our earth, or have tenanted it in past time.

It admits of being divided under two grand heads: Morphology, which treats of Form; and Physiology, which treats of Function; and besides these there are certain departments of biological study to which both Morphology and Physiology contribute, such as Classification, Distribution, and that department of research which is concerned with the origin and causes of living and extinct forms.

By the aid of observation and experiment we obtain the elements which are to be combined and developed into a science of living beings, and it is the function of the scientific method to indicate the mode in which the combinations are to be effected, and the path

* Extracts from the opening address before Section D—Biology—of the British Association for the Advancement of Science, delivered Sept. 18, 1873.

which the development must pursue. Without it the results gained would be but a confused assemblage of isolated facts and disconnected phenomena; but, aided by a philosophic method, the observed facts become scientific propositions; what was apparently insignificant becomes full of meaning, and we get glimpses of the consummate laws which govern the whole.

*Classification an Expression of Affinities.*—Hitherto we have been considering the individual organism without any direct reference to others. But the requirements of the biological method can be satisfied only by a comparison of the various organisms one with the other. Now the grounds of such comparison may be various, but what we are at present concerned with will be found in anatomical structure and in developmental changes; and in each of these directions facts of the highest order and of great significance become apparent.

By a carefully regulated comparison of one organism with another, we discover the resemblances as well as the differences between them. If these resemblances be strong, and occur in important points of structure or development, we assert that there is an affinity between the compared organisms, and we assume that the closeness of the affinity varies directly with the closeness of the resemblance.

It is on the determination of these affinities that all philosophic classification of animals and plants must be based. A philosophical classification of organized beings aims at being a succinct statement of the affinities between the objects so classified, these affinities being at the same time so set forth as to have their various degrees of closeness and remoteness indicated in the classification.

Affinities have long been recognized as the grounds of a natural biological classification, but it is only quite lately that a new significance has been given to them by the assumption that they may indicate something more than simple agreement with a common plan—that they may be derived by inheritance from a common ancestral form, and that they therefore afford evidence of a true blood relationship between the organisms presenting them.

The recognition of this relationship is the basis of what is known as the Descent Theory. No one doubts that the resemblances we notice among the members of such small groups as those we name species are derived by inheritance from a common

ancestor, and the Descent Theory is simply the extension to the larger groups of this same idea of relationship.

If this be a true principle, then biological classification becomes an exposition of family relationship — a genealogical tree in which the stem and branches indicate various degrees of relationship and direct and collateral lines of descent. It is this conception which takes classification out of the domain of the purely morphological.

*Affinity determined by the study of Anatomy and Development.*— From what has just been said it follows that it is mainly by a comparison of organisms in their anatomical and developmental characters that their affinities are discoverable. The structure of an organism will in by far the greater number of cases be sufficient to indicate its true affinity, but it sometimes happens that certain members of a group depart in their structure so widely from the characters of the type to which they belong, that without some other evidence of their affinities no one would think of assigning them to it. This evidence is afforded by development.

*A Philosophical Classification cannot form a single Rectilineal Series.*— A comparison of animals with one another having thus resulted in establishing their affinities, we may arrange them into groups, some more nearly, others more remotely related to one another. The various degrees and directions of affinity will be expressed in every philosophical arrangement, and as these affinities extend in various directions, it becomes at once apparent that no arrangement of the animal or vegetable kingdom, in a straight line ascending like the steps of a ladder from lower to higher forms, can give a true idea of the relations of living beings to one another. These relations, on the contrary, can be expressed only by a ramified and complex figure which we have already compared to that of a genealogical tree.

*Distribution and Evolution.*— Another very important department of biological science is that of the distribution of organized beings. This may be either distribution in space, geographical distribution: or distribution in time, palæontological distribution. Both of these have of late years acquired increased significance, for we have begun to get more distinct glimpses of the laws by which they are controlled, of the origin of faunas and floras, and of the causes which regulate the sequence of life upon the earth. Time, however, will not allow me to enter upon this subject as fully as its interest and importance would deserve, and a

few words on palæontological distribution are all that I can now venture on.

The distribution of organized beings in time has lately come before us in a new light by the application to it of the hypothesis of evolution. According to this hypothesis, the higher groups of organized beings now existing on the earth's surface have come down to us, with gradually increasing complexity of structure, by continuous descent from forms of extreme simplicity which constituted the earliest life of our planet.

In almost every group of the animal kingdom the members which compose it admit of being arranged in a continuous series passing down from more specialized, or higher, to more generalized or lower forms; and if we have any record of extinct members of the group, the series may be carried on through these. Now while the descent hypothesis obliges us to regard the various terms of the series as descended from one another, the most generalized forms will be found among the extinct ones, and the farther back in time we go the simpler do the forms become.

By a comparison of the forms so arranged we obtain, as it were, the law of the series, and can thus form a conception of the missing terms and continue the series backwards through time, even where no record of the lost forms can be found, until from simpler to still simpler terms we at last arrive at the conception of a term so generalized that we may regard it as the primordial stock, the ancestral form from which all the others have been derived by descent.

This root form is thus not actually observed, but is rather obtained by a process of deduction, and is therefore hypothetical. We shall strengthen, however, its claims to acceptance by the application of another principle. The study of embryology shows that the higher animals, in the course of their development, pass through transitory phases which have much in common with the permanent condition of lower members of the type to which they belong, and therefore with its extinct representatives. We are thus enabled to lay down the further principle that the individual, in the course of its own development from the egg to the fully formed state, recapitulates within that short period of time the various forms which its ancestry presented in consecutive epochs of the world's history; so that if we knew all the stages of its individual development, we should have a long line of its descent.

Through the hypothesis of evolution, palæontology and embryology are thus brought into mutual bearing on one another.

Let us take an example in which these two principles seem to be illustrated. In rocks of the Silurian age there exist in great profusion the remarkable fossils known as graptolites. These consist of a series of little cups or cells arranged along the sides of a common tube, and the whole fossil presents so close a resemblance to one of the Sertularian hydroids, which inhabit the waters of our present seas, as to justify the suspicion that the graptolites constitute an ancient and long since extinct group of the Hydroida. It is not, however, with the proper cells or hydrothecæ of the Sertularians that the cells of the graptolite most closely agree, but rather with the little receptacles which in certain Sertularinæ belonging to the family of the Plumularida we find associated with the hydrothecæ, and which are known as "Nematophores." A comparison of structure then shows that the graptolites may with considerable probability be regarded as representing a Plumularia in which the hydrothecæ had never been developed and in which their place had been taken by the nematophores.

Now it can be shown that the nematophores of the living Plumularida are filled with masses of protoplasm which have the power of throwing out pseudopodia, or long processes of their substance, and that they thus resemble the Rhizopoda, whose soft parts consist entirely of a similar protoplasm and which stand among the Protozoa, or lowest group of the animal kingdom. If we suppose the hydrotheca suppressed in a plumularian, we should thus nearly convert it into a colony of Rhizopoda, from which it would differ only in the somewhat higher morphological differentiation of its cænosarc or common living bond, by which the individuals of the colony are organically connected. And, under this view, just such a colony would a graptolite be, waiting only for the development of hydrotheca to raise it into the condition of a plumularian.

Bringing now the evolution hypothesis to bear upon the question, it would follow that the graptolite may be viewed as an ancestral form of the Sertularian hydroids, a form having the most intimate relations with the Rhizopoda; that hydranths and hydrothecæ became developed in its descendants; and that the rhizopodal graptolite became thus converted, in the lapse of ages, into the hydroidal Sertularian.

This hypothesis would be strengthened if we found it agreeing

with the phenomena of individual development. Now such Plumularida as have been followed in their development from the egg to the adult state do actually present well-developed nematophores before they show a trace of hydrothecæ, thus passing in the course of their embryological development through the condition of a graptolite, and recapitulating within a few days stages which it took incalculable ages to bring about in the palæontological development of the tribe.

I have thus dwelt at some length on the doctrine of evolution because it has given a new direction to biological study and must powerfully influence all future researches. Evolution is the highest expression of the fundamental principles established by Mr. Darwin, and depends on the two admitted faculties of living beings—*heredity*, or the transmission of characters from the parent to the offspring; and *adaptivity*, or the capacity of having these characters more or less modified in the offspring by external agencies, or it may be by spontaneous tendency to variation.

The hypothesis of evolution may not, it is true, be yet established on so sure a basis as to command instantaneous acceptance; and for a generalization of such vast significance no one can be blamed for demanding for it a broad and indisputable foundation of facts. Whether, however, we do or do not accept it as firmly established, it is at all events certain that it embraces a greater number of phenomena and suggests a more satisfactory explanation of them than any other hypothesis which has yet been proposed.

With all our admiration, however, for the doctrine of evolution as one of the most fertile and comprehensive of philosophic hypotheses, we cannot shut our eyes to the difficulties which lie in the way of accepting it to the full extent which has been sometimes claimed for it. It must be borne in mind that though among some of the higher vertebrata we can trace back for some distance in geological time a continuous series of forms which may safely be regarded as derived from one another by gradual modification—as has been done, for example, so successfully by Prof. Huxley in the case of the horse—yet the instances are very few in which such a sequence has been actually established; while the first appearance in the earth's crust of the various classes presents itself in forms which by no means belong to the lowest or most generalized of their living representatives. On this last fact, however, I do not

lay much stress, for it will admit of explanation by referring it to the deficiency of the geological record, and then demanding a lapse of time—of enormous length, it is true—during which the necessary modifications would be in progress before the earliest phase of which we have any knowledge could have been reached.

Again, we must not lose sight of the hypothetical nature of those primordial forms in which we regard the branches of our genealogical tree as taking their origin; and while the doctrine of the recapitulation of ancestral forms has much probability, and harmonizes with the other aspects of the evolution doctrine into a beautifully symmetrical system, it is one for which a sufficient number of actually observed facts has not yet been adduced to remove it altogether from the region of hypothesis.

Even the case of the graptolites already adduced is an illustration rather than a proof, for the difficulty of determining the true nature of such obscure fossils is so great that we may be altogether mistaken in our views of their structure and affinities.

To me, however, one of the chief difficulties in the way of the doctrine of evolution, when carried out to the extreme length for which some of its advocates contend, appears to be the unbroken continuity of inherited life which it necessarily requires through a period of time whose vastness is such that the mind of man is utterly incapable of comprehending it. Vast periods, it is true, are necessary in order to render the phenomena of evolution possible; but the vastness, which the antiquity of life, as shown by its remains in the oldest fossiliferous strata, requires us to give to these periods, may be even greater than is compatible with continuity.

We have no reason to suppose that the reproductive faculty in organized beings is endowed with unlimited power of extension, and yet to go no farther back than the Silurian period—though the seas which bore the Eozoon were probably as far anterior to those of the Silurian as these are anterior to our own—the hypothesis of evolution requires that in that same Silurian period the ancestors of the present living forms must have existed, and that their life had continued by inheritance through all the ramifications of a single genealogical tree down to our own time; the branches of the tree, it is true, here and there falling away, with the extinction of whole genera and families and tribes, but still some always remaining to carry on the life of the base through a period of time

to all intents and purposes infinite. It is true that in a few cases a continuous series of forms regularly passing from lower to higher degrees of specialization, and very probably connected to another by direct descent, may be followed through long geological periods, as, for example, the graduated series already alluded to, which may be traced between certain mammals of the Eocene and others living in our own time, as well as the very low forms which have come down to us apparently unmodified from the epoch of the Chalk. But incalculably great as are these periods, they are but as the swing of the pendulum in the millennium, when compared to the time which has elapsed since the first animalization of our globe.

Is the faculty of reproduction so wonderfully tenacious as all this, that through periods of inconceivable duration, and exposed to influences the most intense and the most varied, it has still come down to us in an unbroken stream? Have the strongest which had survived in the struggle for existence necessarily handed down to the strongest which should follow them the power of continuing as a perpetual heirloom the life which they had themselves inherited? Or have there been many total extinctions and many renewals of life—a succession of genealogical trees, the earlier ones becoming old and decayed, and dying out, and their place taken by new ones which have no kinship with the others? Or, finally, is the doctrine of evolution only a working hypothesis which, like an algebraic fiction, may yet be of inestimable value as an instrument of research? For as the higher calculus becomes to the physical inquirer a power by which he unfolds the laws of the inorganic world, so may the hypothesis of evolution, though only a hypothesis, furnish the biologist with a key to the order and hidden forces of the world of life. And what Leibnitz and Newton and Hamilton have been to the physicist, is it not that which Darwin has been to the biologist?

But even accepting as a great truth the doctrine of evolution, let us not attribute to it more than it can justly claim. No valid evidence has yet been adduced to lead us to believe that inorganic matter has become transformed into living, otherwise than through the agency of a preëxisting organism, and there remains a residual phenomenon still entirely unaccounted for. No physical hypothesis founded on any indisputable fact has yet explained the origin of the primordial protoplasm, and, above all, of its marvellous properties which render evolution possible.

Accepting, then, the doctrine of evolution in all freedom and in all its legitimate consequences, there remains, I say, a great residuum unexplained by physical theories. Natural Selection, the Struggle for Existence, the Survival of the Fittest, will explain much, but they will not explain all. They may offer a beautiful and convincing theory of the present order and fitness of the organic universe, as the laws of attraction do of the inorganic, but the properties with which the primordial protoplasm is endowed—its heredity and its adaptivity—remain unexplained by them, for these properties are their cause and not their effect.

For the cause of this cause we have sought in vain among the physical forces which surround us, until we are at last compelled to rest upon an independent volition, a far-seeing intelligent design. Science may yet discover even among the laws of physics the cause it looks for; it may be that even now we have glimpses of it; that those forces among which recent physical research has demonstrated so grand a unity—light, heat, electricity, magnetism—when manifesting themselves through the organizing protoplasm, become converted into the phenomena of life, and that the poet has unconsciously enunciated a great scientific truth when he tells us of

> "Gay lizards glittering on the walls
> Of ruined shrines, busy and bright
> As though they were *alive with light*."

But all this is only carrying us one step back in the grand generalization. All science is but the intercalation of causes, each more comprehensive than that which it endeavors to explain, between the great primal cause and the ultimate effect.

I have thus endeavored to sketch for you in a few broad outlines the leading aspects of biological science, and to indicate the directions which biological studies must take. Our science is one of grand and solemn import, for it embraces man himself and is the exponent of the laws which he must obey. Its subject is vast, for it is life, and life stretches back into the illimitable past, and forward into the illimitable future. Life, too, is everywhere. Over all this wide earth of ours, from the equator to the poles, there is scarcely a spot which has not its animal or its vegetable denizens—dwellers on the mountain and on the plain, in the lake and on the prairie, in the arid desert and the swampy fen; from the tropical forest with its strange forms and gorgeous colors and myriad voices, to the ice-fields of polar latitudes and those silent

seas which lie beneath them, where living things unknown to warmer climes congregate in unimaginable multitudes. There is life all over the solid earth; there is life throughout the vast ocean, from its surface down to its great depths, deeper still than the lead of sounding line has reached.

And it is with these living hosts, unbounded in their variety, infinite in their numbers, that the student of biology must make himself acquainted. It is no light task which lies before him — no mere pastime on which he may enter with trivial purpose, as though it were but the amusement of an hour; it is a great and solemn mission to which he must devote himself with earnest mind and with loving heart, remembering the noble words of Bacon: —

"Knowledge is not a couch whereon to rest a searching and restless spirit; nor a terrace for a wandering and variable mind to walk up and down with a fair prospect; nor a tower of state for a proud mind to raise itself upon; nor a fort or commanding-ground for strife and contention; nor a shop for profit and sale; but a rich storehouse for the glory of the Creator, and the relief of man's estate."

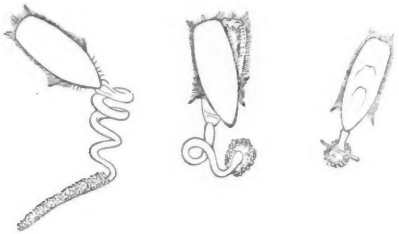
## REVIEWS AND BOOK NOTICES.

The Systematic Position of the Brachiopods.* — To those accustomed to find the Brachiopods invariably mentioned in palæontological as well as zoological works as shell-fish, with no hint of an affinity to any other class of animals, the author's remark at the beginning of his essay that "the Brachiopoda are true worms, with possibly some affinities to the Crustacea, and that they have no relations to the Mollusca, save what many other worms may possess in common with them," will seem in its nature somewhat iconoclastic. But we should remember that Cuvier regarded the barnacles as Mollusca, and it was not until 1830 that Thompson and Burmeister demonstrated from their mode of growth that these shell-bearing animals were undoubted Crustacea; the Serpulæ and Spirorbes were regarded as shell-fish by many collectors, and even

*The Systematic Position of the Brachiopoda. By Edward S. Morse. (From the Proceedings of the Boston Society of Natural History, xv. Published August, 1873. 8vo. pp. 60.)

the bivalve phyllopods (Estheria) of our fresh-water pools are daily mistaken by collectors for species of Cyclas. On the other

Fig. 1.

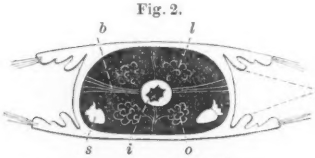


Lingula pyramidata.

hand certain worms, such as the flat worms or Planarians, have been regarded as allied to the snails and slugs by good naturalists.

We will now attempt, so far as is possible, to condense the paper of Professor Morse by giving his chief arguments for con-

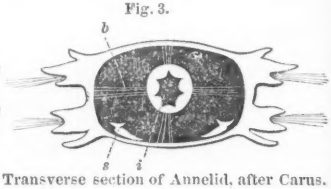
Fig. 2.




Transverse section of Lingula.

*b*, bands suspending intestine in perivisceral cavity; *i*, intestine; *s*, segmental organ; *o*, ovaries; *l*, liver; *g*, gills; *se*, *se*, setæ.

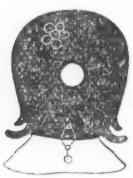
Fig. 3.




Transverse section of Annelid, after Carus.

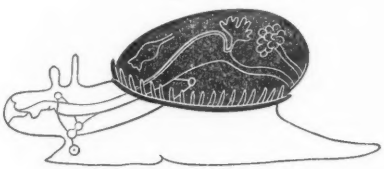
*b*, bands suspending intestine in perivisceral cavity; *i*, intestine; *s*, segmental organ; *se*, *se*, setæ.

Fig. 4.



Transverse section of molluscan archetype, after Carus.

Fig. 5.



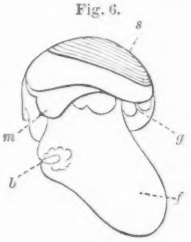
Molluscan archetype, after Carus.

sidering the "Lamp-shells" as worms. He first defines the two classes. The worms have an elongate form, while that of the

mollusk is concentrated or sac-like; hence the term Saccata applied to them by Professor Hyatt.

In the mollusk the viscera are usually contained in a large chamber protruding above the foot, while in the worm "the symmetry of the body is never disturbed by the viscera." In the mollusk, moreover, the mantle is sac-like, "inclosing a conspicuous cavity," and protecting the gills, while the alimentary canal is straight in the worm, rarely convoluted, and suspended freely in the perivisceral cavity, by bands (Fig. 1, b); in the mollusk this organ is always convoluted, and intimately blended, or united, with other organs. The nervous system of the worms consists of a nerve collar from which start two parallel chains of ganglia, while in the mollusks there is a nerve collar, but no double chain, and instead, nerves are thrown out to the sensory, motor and parieto-splanchnic regions. The eggs of worms are usually (except in the leeches) set free in the general cavity of the body, which is not the case with the mollusks. Lastly, the embryo mollusk (Fig. 6) early develops a shell composed of one or two pieces, while the embryonic worm is usually distinctly ringed, as seen on the opposite page.

Fig. 6.

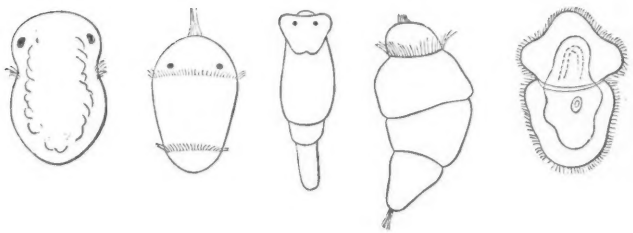



Embryo of Lamellibranchiate.

*s*, shell; *m*, mouth; *f*, foot; *b*, byssal gland; *g*, gills.

Here, in passing, we would remark that while the mollusks are admirably characterized, the author has, we think, failed to give sufficient importance to the most fundamental and important character in the typical worm. Certainly the ringed, segmented structure of the worm is that which, more than any other character, separates it from other animals, and when the rings are absent, as in the Planarians, Nematoids and other low worms, this is an adaptive character resulting from their peculiar habits. Moreover it should be remembered that our author regards the Brachiopods as a division of Chætopod worms, in which the segments are invariably present, and form the most important feature of those animals. Again, we fail to find any reference to the relation of the most important anatomical systems (the nervous, circulatory system and digestive canal) to the walls of the body. The correlation in structure of the nervous system of the higher worms to the segmented structure is also most intimate and remarkable.

Fig. 7. Fig. 8. Fig. 9. Fig. 10. Fig. 11.



Embryos of Worms.

Fig. 7. Serpula; Fig. 8, Spio; Fig. 9, Melicerta (Rotifer); Fig. 10, Pilcolaria; Fig. 11, Phoronis; (Fig. 7, original; Figs. 8 and 10, from Claparède; Fig. 9, from Huxley; Fig. 11, from Dyster.)

Fig. 12. Fig. 13. Fig. 14.

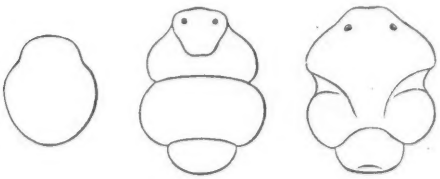
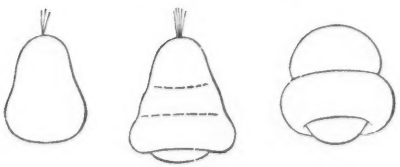


Fig. 15. Fig. 16. Fig. 17.



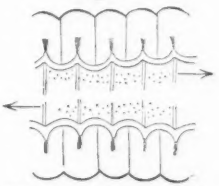
Embryos of Brachiopods.

Figs. 12, 13, 14, Thecidium (from Lacaze Duthiers).

Figs. 15, 16, 17, Terebratulina (original).

To this deficiency in the definitions, otherwise so full, we shall recur in noticing the author's conclusions as to the more immediate relationship of the Brachiopoda. It may also be noticed that in none of the diagrams of the transverse sections of the worms are the positions of the dorsal vessel or nervous cord in relation to the body walls indicated; and in this respect the same view of the mollusk is unsatisfactory. This is said not so much by way of criticism, as to call attention to important differences between the Brachiopods and Chætopodous worms, which demand serious consideration in accepting the conclusions as to the precise systematic position of the Brachiopods claimed by the author.

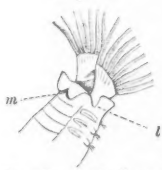
Fig. 18.



Portion of Peduncle of *Lingula pyramidata*, showing annulations, and circulation of fluid within.

Farther on, in speaking of the general proportions of the body, it seems that the author does not lay much stress on the ringed structure of the higher worms, of which it should be borne in mind he considers the Brachiopods to form a division. Thus it is stated, almost casually, that "a prominent character of the higher worms is the annulations or rings marking the body." As, however, the annulations are wanting in certain low worms (*i.e.* the Gephyrea or Sipunculoid worms, Sagitta, Nematoidea, Acanthocephala*) the absence of this character in the Brachiopods is unimportant; still, however, the peduncle of Lingula is "partially annulated" (Fig. 18).

Fig. 19,




Showing cephalic collar of Sabella.
*m.* median dorsal notch; *l*, lateral notch.

The comparison between the mollusks and worms is then extended to the integumentary organs. Here, in an exceedingly suggestive way, the author shows that in the worms the integument is rarely ever extended beyond the limits of the body; but when

Fig. 20.

Head of Discina.

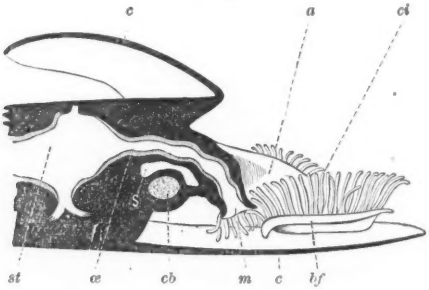
Fig. 21.

Head of Sabella.

*It should be borne in mind that these worms are mostly parasitic, or, as in Sagitta and Sipunculus, very aberrant forms, and the absence of rings is probably a secondary or adaptive character.

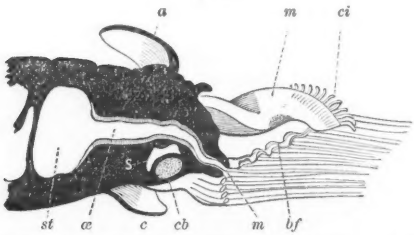
it is it forms a broad cephalic collar, "covering the base of the arms in those worms possessing it (as in Sabella, Fig. 19), while in the Brachiopoda the collar covers and protects the arms," and this collar is not to be compared with the mantle of mollusks. On

Fig. 22.




Longitudinal section of anterior portion of Lingula.

Fig. 23.




Longitudinal section of anterior portion of *Amphitrite ventrilabrum*.

*m*, mouth; *œ*, œsophagus; *st*, stomach; *a*, arm; *ci*, cirri; *bf*, brachial fold; *cb*, cartilaginous base of arm; *s*, sinus leading to arm; *cc*, cephalic collar or pallial membrane.

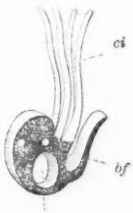
page 27 the cephalic region of the true worms is discussed, and the intimate relationship between the head of certain worms, such as Sabella and Amphitrite, and that of the Brachiopods, shown. This can be seen by a glance at the accompanying figures. We cannot farther abstract the condensed statement of the author. By making a longitudinal section of the worm Amphitrite, and the brachiopod Lingula, the most interesting relationship may be detected (Figs. 22 and 23).

Considering the arms alone we are told that a transverse section of a right arm of Amphitrite (Fig. 24) resembles that of Lingula, (Fig. 25) much more than "corresponding sections of two Brachiopods resemble each other."

Fig. 24.

Transverse section of arm of *Amphitrite ventricosa*.

Fig. 25.

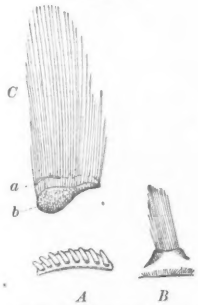



Transverse section of arm of *Lingula pyramidata*.

*ci*, cirri; *bf*, brachial fold; *s*, sinus.

Bristles like those of worms, moved by muscles, and quite unlike the stiff spines of the Chitons occur in the Brachiopods. The muscles of the integument bear the closest resemblance to those of worms. The perivisceral cavity is shown to be, like that of worms, lined with a delicate membrane and strongly ciliated. Prof. Morse has succeeded in finding a vessel on the dorsal surface of the intestine of Lingula, but not the vesicle described by Hancock. But still he, as well as others,

Fig. 26.




Chiton spiculosus, Gray.

*A*, side view of Chiton, magnified; *B*, side view of one tuft of bristles in the girdle; *C*, a tuft of bristles largely magnified; *a*, line of girdle; *b*, base of tuft.

Fig. 27.

Amicula Emersonii.

*a*, cartilaginous layer; b, muscular layer.

Fig. 28.

Nerine cirratulus.

Deciduous seta of larval worm, *Nerine cirratulus*, from Claparède.

Fig. 29.

Discina.

Deciduous seta of larval Discina, from Fritz Müller.

has never succeeded in studying the vascular system satisfactorily. He, however, alludes to a pseudo-hæmal system of organs, being a set of membranes which invest the oviducts, and has traced the circulation in living Rhynchonellæ. This subject, and the circula-

tion of Lingula, which has red blood, is reserved for discussion in a subsequent memoir. The digestive canal of the Brachiopods, as well as the circulatory system, does not compare well with those of the normal worms.

"The anomalous features presented by some worms, in the absence of an anus, or the possession of a cœcal stomach, and the anterior termination of the anus, are fully repeated in the Brachiopoda. In one entire division of the Brachiopoda, represented by Terebratula, the stomach terminates in a cœcal sac. In Terebratulina the alimentary tract is closed posteriorly. Nor has the slightest trace of an anus been detected in Thecidium, Waldheimia, Rhynchonella, and several other genera that have been examined. In the very early stages of Terebratulina, I have seen the rejectamenta escape from the mouth, and in no case has the appearance of an anal perforation been discovered. In Terebratulina, the alimentary tract pursues a direct antero-posterior course without convolutions, while in Lingula and Discina the anus terminates anteriorly on the right side. In Lingula, the intestine makes a few turns, while in Discina it makes a single turn to the right."

The nervous system is much as in the worms, there being two lateral ventral cords, widely separated (in Lingula these lateral threads seem to be double and connected by commissures) and connected at the œsophagus by ganglionic enlargements, which send off threads to the pallial membranes, and to the various muscles. The breathing organs of Brachiopods are contained in the pallial membrane, which is divided into two oblique transverse sinuses, apparently resembling the interior of the branchia of a worm. The genital organs are almost identical with those of worms, as may be seen by a study of Figs. 30–40.

We now quote the author's conclusions in his own words:—

"In considering the assemblage of remarkable characters in the Brachiopods, we must recognize in them a truly ancient type, and consequently a synthetic, or comprehensive type. Thus while we do not find them in all their characters resembling any one group of worms, I have endeavored to show that all their features, to a greater or less degree, are shared by one or the other of the various groups of the Vermes, with one or two features shared by the Arthropods.

It is important to remark in this connection that most of the ancient groups differ from present groups with which they are associated. Thus the Trilobites are widely unlike modern Crustaceans, Milne-Edwards and Van Beneden suggesting their affini-

Fig. 30. Fig. 31. Fig. 32.

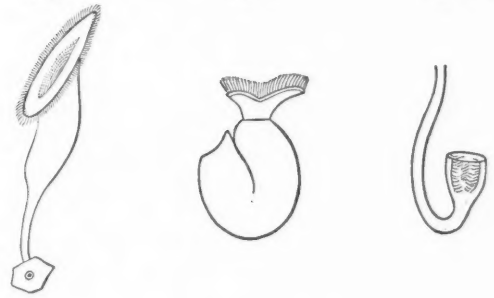
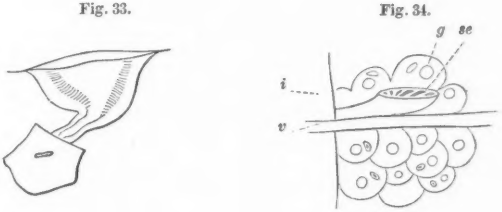


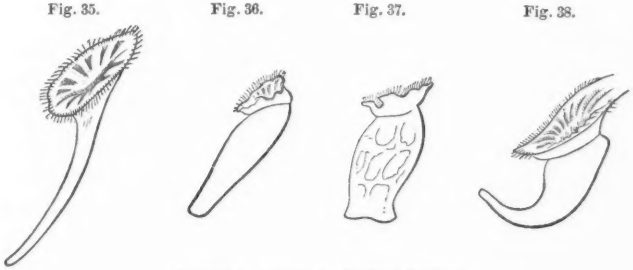
Fig. 33. Fig. 34.




Segmental organs of worms.

Fig. 30, Lumbricus; Fig. 31, Pectinaria; Fig. 32, Eunice; Fig. 33, Stylodrilus; Fig. 34, Nereis; *se*, segmental organ, *g*, genitalia, *v*, vascular channel, *i*, intestine; Fig. 30 is from Lankester, the rest from Claparède.

Fig. 35. Fig. 36. Fig. 37. Fig. 38.



Segmental organs of the Brachiopods.

Fig. 35, Discina; Fig. 36, Lingula; Fig. 37, Rhynchonella; Fig. 38, Terebratulina. These figures are from Morse's own studies.

ties with the Arachnids. Tetrabranchiate Cephalopods are widely separated from the Dibranchiate Cephalopods. Crinoids are widely unlike modern Echinoderms. In other words, among the Mollusks, Echinoderms and Crustaceans are ancient types widely different from the modern types with which they are correlated.

So in worms we should expect to see ancient types, while presenting a high organization, yet differing from present groups to which they are unquestionably related. And from the high complication of structure of the Brachiopods, Tetrabranchiates, and other ancient types, it would seem that in their culmination in ancient times they had the same relation to animals living then as the higher groups of present times bear to their associates. As to the more ancient forms of Brachiopods, it is probable with them, as with other groups, that their lower members were soft-bodied, and the argument that has been urged, as militating against Darwin, that animals of high complication of structure occur in the older groups, becomes valueless, when we consider that the lower forms of their respective groups are more often soft-bodied, and that complicated forms of earlier times were also culminating forms of preëxisting groups. * * * * *

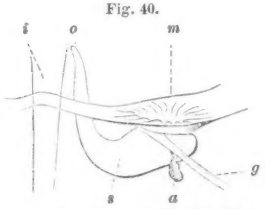
Fig. 39.

Segmental organ of *Alciope Cantrainii*.

*m*, inner mouth, of segmental organ; *o*, external orifice of ditto; *t*, testis.

To sum up the whole then:—ancient Chætopod worms culminated in two parallel lines, on the one hand in the Brachiopods, and on the other, in the fixed and highly cephalized Chætopods. The divergence of the Brachiopods, having been attained in more ancient times, a few degraded features are yet retained, whose relationships we find in the lower Vermes; while from their later divergence the fixed and cephalized Annelides are more closely allied to present free Chætopods.

Fig. 40.




Segmental organ of Terebratulina.

*s*, segmental organ; *m*, inner mouth of ditto; *o*, external orifice of ditto; *g*, genital band; *a*, accessory vesicle; *t*, intestine.

And so we must regard the Brachiopods as *ancient cephalized Chætopods*, while Serpula, Amphitrite, Sabella, Protula and others, may be regarded as *modern* (later) *cephalized Chætopods.*"

Aside from the great interest of the memoir, the skilful and concise manner in which the facts, — many discovered by the author himself after the most patient study, which would in themselves commend the work to every one — are

presented, we think the author has demonstrated, in the clearest manner, that the Brachiopods are worms. And we congratulate ourselves that this important discovery of the obscure relationship of these animals has been made by an American naturalist, with the advantages presented in this country.

Still, from the facts so clearly set forth, we doubt whether the Brachiopods should, even with all the important Chætopod characters they present, be included in the division of Chætopod worms, but rather look forward to their being united with the Polyzoa in a division equivalent, perhaps, to the rest of the worms, at least the Chætophora and Discophora combined, and forming a somewhat parallel group. The Brachiopods, certainly, from Prof. Morse's own showing, have not either such a nervous system, or respiratory or circulating organs, or an annulated body, as would warrant their union with the Chætopods. He has fully proved that they are a synthetic type, combining the features of different groups of worms and other articulate animals, and in doing so he virtually forbids our sharing his view as to their special Chætopod nature. We would prefer, in speculating on their ancestry, to derive the Brachiopods and Polyzoa from a common vermian ancestry, not much higher than the Rotifers, from which sprung two stems; one resulting in the Polyzoa, and the other in the more highly and specially-developed Brachiopods, while the Chætopods were probably derived independently from an ancestry higher perhaps, but vaguely resembling the Rotifers. As to the molluscan affinities of these animals, let those prove them who can, after going over step by step the track revealed by the patient and toilsome researches of our author.

North American Grasshoppers.*—Dr. Hayden proposes to collect, in a single quarto volume, papers upon the zoology and botany of the Rocky Mountain region explored by him in his government surveys. The fishes and reptiles will be elaborated by Professor Cope, the botany by Professor Porter, Hemiptera by Mr. Uhler, Coleoptera by Dr. Horn, birds by Dr. Coues and mammals by Professor Gill. The first part, on a portion of the Orthoptera, is now published, and if the whole work is executed upon the same scale, one volume cannot contain it all: let us hope that it will not. In the part before us, Dr. Thomas does not

*Report of the U. S. Geological Survey of the Territories. F. V. Hayden, Geologist in charge. Vol. v. Zoology and Botany. Part i. Synopsis of the Acrididæ of North America, by Cyrus Thomas, Ph. D. 4to. pp. x, 262. Washington, 1873.

confine himself to the study of Rocky Mountain forms, but includes the Acridians of the whole of North America. It is preceded by an introductory statement of the external and internal structure of insects of this group, with especial reference to parts used in description; by an exposition of the author's idea of classification and by notes on the geographical distribution of the genera and species. In the body of the work one hundred and twenty species and twenty-five genera of U. S. Acridians are described; forty species and four genera as new. In the second part, the extra-limital species are described, but no new species are mentioned; and nearly all the descriptions, as well as many of those in the first part, are borrowed; it would have been well if the author had appended the describers' names. The work is accompanied by a well executed plate (none too large) in which, strange to say, nearly one-third of the figures are of European species,—copied from Fischer's work; surely, from the abundant material in the author's possession, suitable specimens could have been found for illustration.

British Marine Seaweeds.*—This is a convenient little book, of which four parts have already appeared, and five or six are to follow. Mr. Grattan, whose home is at Torquay in Devonshire, a place famous in the history of British natural history, is a thorough enthusiast in seaweeds, and finding that the standard treatises on them were too scientific for the use of ordinary amateurs, and withal quite expensive, he has prepared this work, which is so simple that the most inexperienced student can readily understand it, while the price, sixpence sterling for each part, is moderate enough. Since a very large proportion of our New England algæ consists of species occurring on the shores of Great Britain, and since Harvey's Nereis, the only work on the algæ of the United States, is costly and not suited to the needs of amateurs, this book will be very useful to those who not only collect, but desire to know something about seaweeds and sea-mosses.—Daniel C. Eaton.

Lubbock's Monograph of the Poduræ.—Sir. John Lubbock has recently published a "Monograph of the Collembola and Thysanura." It forms a volume, in octavo, of the Ray Society. The

* British Marine Algæ: being a popular account of the Seaweeds of Great Britain, their collection and preservation. Illustrated. By W. H. Grattan. London: "The Bazaar" office, 32 Wellington street, Strand, W. C.

work is beautifully, indeed lavishly, illustrated with seventy-eight plates, of which thirty-one are colored, nearly every plate representing a distinct species highly magnified. The work will commend itself to microscopists, as it is accompanied by an essay, by Mr. Joseph Beck, on the scales of certain Poduræ, with figures of the scales highly magnified.

## BOTANY.

Irritability of the Leaves of the Sundew.—In our last number attention was called to the old observations of Roth respecting the irritability of Drosera leaves. It will be interesting to our readers to glance at a short abstract of Roth's treatise.*

The author begins by referring to the difficulty of drawing any line of demarcation between animals and plants. Some plants were believed, by the ancient philosophers, to possess a soul, since they appear to share with animals a kind of sensitiveness and motion. The word *sensitiveness* is, on some accounts, objectionable and it may be better, therefore, to employ the term *irritability*. A few plants possess this irritability in a high degree, but may we not ascribe to others, irritability less in degree? The author next refers to the kindred plants *Dionæa muscipula* and *Drosera*, intimating that the latter has, in a slight degree, the kind of irritability which characterizes the flytrap. He then describes the action of Dionæa in catching insects, and proceeds to give an account of the two more common species of sundew, *Drosera rotundifolia* and *longifolia*.

In July, 1779, while on a botanical excursion, Roth observed that some leaves of both species of Drosera had closed. Upon separating the infolded surfaces, he discovered dead insects, whereupon he asked himself whether sundew did not act just as Dionæa does. He transferred healthy plants to his house and proceeded to make the following experiments:—

1st. He placed, by a pair of pincers, an ant on the open leaf of *Drosera rotundifolia*. As soon as the ant tried to recover its freedom, the hairs of the leaf turned towards his body, and the edges of the leaf rolled over towards him. In a few minutes the ant was

*Von der Reizbarkeit der Blätter des sogenannten Sonnenthaues (Drosera rotundifolia, longifolia.) Beyträge zur Botanik, Erster theil. s. 60. Von Albrecht Wilhelm Roth. Bremen, 1782. On the Irritability of the Leaves of the so-called Sundew (Drosera rotundifolia). p. 60. By Albrecht Wilhelm Roth. 1782.

concealed in the infolded leaf. The insect was killed by this imprisonment. This experiment was repeated upon other leaves and with nearly the same results.

2nd. He placed a little fly, being careful not to injure it, on a leaf of *Drosera rotundifolia*. The insect made some movements to gain his liberty, but he soon died, as did the ants in the previous experiments. The hairs bent inwards as before. The experiment began at eleven A. M. At five o'clock P. M. the leaf had completely closed and held the fly within.

The third observation was made upon a specimen of *Drosera longifolia*. An ant was employed, and with the same results as before. It is interesting to note the following on p. 64:—"Dieses Zusammenklappen erfolgt aber auch ebenso wenn man ein Strohhälmchen oder eine Stecknadel zwischen dieselben bringt."

The author makes some remarks relative to the similarity of action in the two genera, Dionæa and Drosera. The most interesting note, however, is that in respect to the *purpose* of the irritability.

"Mr. Ellis suggests in his letter to Linnæus that nature, by the formation of the leaf of Dionæa, may perhaps have designed it to aid in its nourishment. Schreber, however, believes it is unlikely that plants should draw nourishment from insects pressed between their leaves. It is certain that we cannot determine positively what object the wise Creator may have had in giving to these plants this wonderful structure and irritability, but I believe that we may assume safely that this structure and faculty of these plants may tend, through this nourishment, to the preservation and propagation of their kind. We cannot yet determine whether these plants may not need for their support animal juices. Besides, knowing as we do that these plants have, chiefly on their leaves, an apparatus by which they may draw from the air foreign bodies for their nourishment, we have no reason to doubt this possibility."

The author claims that no one had preceded him in this investigation.

In 1802, Roth published the following note (Neue Beyträge zur Botanik, von Al. W. Roth. Erster Theil. Frankf. am Mayn. 1802. p. 185). "In Droseris Germanicis simile phænomenon observatur et non minus miraculosum, quam in Dionæa muscipula, Foliorum scilicet pili apice oriferi ab Insecto irritati inflectuntur, inflexi Insectum incarcerant, et folium demum complicatum incarceratum tenet."

Passing over the statements in De Candolle's "Introduction à l'étude de la Botanique" (Tome 1, p. 415) 1835; in Treviranus' Physiologie der Gewächse (1838, vol. ii, s. 759), in Meyen's Neues System der Planzen Physiol. vol. iii, s. 550, we find in Botanische Zeitung, June 29, 1860, an article by Nitschke, detailing an extensive series of experiments upon Drosera. These results, together with the very curious observations published in Comptes Rendus last year, we will present at an early day, feeling quite confident that many of our readers will carefully repeat some of these experiments during the coming season. — G. L. G.

## ZOOLOGY.

A New Ægerian Maple Borer. — Last June my attention was drawn to numerous castings, similar to those of the peach tree borer (*Trochilium exitiosum* Say) projecting from the trunk of the soft maple trees surrounding our university yard. Having approached one of these trees I found several moths already hatched out, the most of the maple trees having been destroyed by this pernicious insect, which, boring in the bark and sap-wood, not only hinders the sap from circulating, but also enfeebles the trunk so that it is no longer able to support the weight of its foliage.

During this summer a dozen of these trees were broken down, and the few still standing are in such a condition that I believe they will not resist the winds of a second season. This condition of things induced me to pay close attention to this insect — studying its habits and collecting specimens. I failed to find it described in any of the entomological works of the university library and I have been informed that Dr. Le Baron, State Entomologist, was not aware of any Ægerians feeding on the maple tree.

My confidence in this second statement having been reënforced by a similar answer of several men of experience that I consulted on the matter, I came to the conclusion that this insect is a new destroyer and enemy of our best shade tree. I therefore give you a description* of this insect, adding what I could observe on its

*Trochilium acericolum, n. sp. The female, the perfect insect of this Ægeria, measures across the wings from 13-16 to 15-16 of an inch; its wings are transparent. Fore wings; the tips yellowish, opaque, with black veins; front margin and fringe black; a steel-blue transverse band beyond their middle. Hind wings with a steel-

habits in the last two months and a half. It feeds on the inner bark and on the sap-wood. When fully fed it spins its cocoon near the surface of the outer bark. Early in the morning it makes its way out of the cocoon and the very thin layer of bark that covers it, leaving the cast skin half emerged from the orifice on the trunk, and appearing in a winged state. The females in laying their eggs, select the roughest places of *any part* of the trunk — and not of the base only, as the *T. exitiosum* — where they deposit them one in a place. The larvæ are found under the bark at any time and in all sizes. — P. GERMADIUS, *Champaign, Ill.*

A SPINOUS FIN IN A MINNOW. — A genus of fishes (*Protistius* Cope) has been recently discovered in the Ecuadorian Andes, which in its general structure appears to belong to the bull-minnows (*Cyprinodontidæ*). Its head and mouth, however, resemble those of a mullet (*Mugil*) and it has a rudimental spinous dorsal fin consisting of a single small spine, which is bound to the back by membrane so as to be capable of but little erection.

## GEOLOGY.

RETURN OF PROFESSOR MARSH'S EXPEDITION.—Prof. O. C. Marsh and party returned to New Haven, November 7th, after an absence of five months in the Rocky Mountain region and on the Pacific Coast. The present expedition had the same object in view as those of previous years, viz: a study of the vertebrate fossils of the west, especially those of the Cretaceous and Tertiary formations. The first explorations this year were made in the Pliocene deposits near the Niobrara River. The party fitted out in June at Fort

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blue spot in the middle of the fore margin; fringe black. TAIL (caudal tuft) deep orange. ABDOMEN, above steel-blue; beneath, except the second ring from the thorax, steel-blue and golden-yellow with a longitudinal orange line in the middle. THORAX shining brown-yellow. LEGS hairy, yellow, spotted with orange and steel-blue; femur of the front pair, orange. Prosternum, heavy orange; mesosternum and metasternum, heavy golden-yellow. HEAD mostly occupied by large black eyes, in the front part of each of which is a white silvery spot. PALPI orange. TONGUE distinct, spiral, yellow, 3-16 of an inch.

The male differs from the female in being somewhat smaller, having the fringe brown-golden; the abdomen, above of a lighter steel-blue, inclining to a bronze, and beneath of a more intense golden-yellow; hairs of the tail of a steel-blue color halfway from the base, and the remaining of paler orange. In a word, he is of a lighter color than the female.

The larva is whitish, hairy, head brown; length 9-10 inch and diameter 1-8 of an inch.

McPherson, Nebraska, and, accompanied by an escort of two companies of U. S. Cavalry, proceeded to the Niobrara, and worked in that country for several weeks. Owing to hostile Indians, the explorations of the party here were attended with much difficulty and danger, but were on the whole quite successful. Many new animals were discovered, and ample material secured for a full investigation of those previously known from that region.

A second expedition was made in August from Fort Bridger, Wyoming, and large collections of Eocene fossil vertebrates were obtained, especially of the *Dinocerata*, *Quadrumana* and *Cheiroptera*, which had first been brought to light by the researches of the party in previous years. A third trip was made in September to the Tertiary beds of Idaho and Oregon, where some interesting discoveries were made. The party went from Oregon to San Francisco by sea, narrowly escaping shipwreck, and then returned east by rail. On the way, short visits were made to localities in Colorado and Kansas, to complete investigations begun last year. The expedition as a whole was very successful, not merely on account of the large number of new animals discovered, but also on account of the extensive collections made to complete the study of those previously found. All of the collections secured are now in the museum of Yale College.

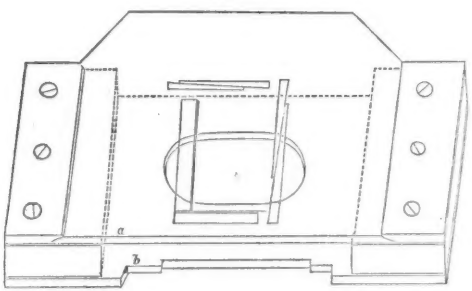
## MICROSCOPY.

A New Section Cutter.—Prof. T. D. Biscoe has contrived a new section cutter which is principally adapted for preparing sections of soft vegetable tissues and organs, such as leaves, buds, etc. It consists essentially of a large glass stage-plate upon which the object is fastened, and a movable frame to slide upon this, carrying a razor blade at an adjustable distance from the plate. This apparatus cuts sections of objects while they are under observation on the stage of the microscope, under powers as high as the $\frac{2}{3}$ inch ($\times$ 80); and with it Prof. Biscoe has been able to cut series of fifteen consecutive sections, each one of which was perfect and the average thickness of which was $\frac{1}{8000}$ inch. The following is his description of the contrivance.

"Fig. 41 is a plate that fits on to the stage of the microscope with a tight friction, yet so that it has movements of an inch or

more in any direction, so that the object can be brought into the field of view; *a* is a glass plate held in place by the two pieces of wood with screws on the right and left; *b* is the wooden base of the affair with an oval opening for the illuminating apparatus to come up; this wooden base being covered on the inner or upper side with velvet to make smooth the friction on the under side of the stage. For use with a mechanical stage this arrangement is modified and much simplified, the large glass plate being merely attached to the stage, whose screw movements enable the object to be brought into the field of view. On the middle of the upper side of the glass plate are cemented four strips of glass as shown, just far enough apart to take in a common glass slide which is held in place by a couple of wedges of common sheet brass; and on the middle of a slide is fastened the object to be cut, either with gum

Fig. 41.




arabic or sometimes with collodion. For holding hard objects like wood the arrangements are not yet quite perfected, but no special difficulty is expected.

Fig. 42 gives a perspective view of the triangular wooden frame that holds a razor blade, *r*, whose edge and back come down lower than the rest of the frame. By means of the three screws with graduated heads the whole frame, razor and all, is raised or lowered from the glass plate (*a*, Fig. 41) on which the triangle rests and slides with these three screws as its feet. These three supporting screws are cut with a thread that counts forty to the inch; the screw head is divided into one hundred equal parts, and can be moved without much difficulty through half of one division, giving a vertical motion of $\frac{1}{8000}$ inch to the cutting edge.

Fig. 43 is a large view of one of the screws, with its indicator. The indicator may be a simple pin set in the wooden frame, but is more convenient if made movable around the axis of the screws, so that when the razor is returned after sharpening they may be all turned around to the 0 of their respective screws and therefore all read alike while the successive cuts are being made. On the side of the indicators are scales which show how many complete revolutions of the screws have been made. These indicators should move quite stiffly, so as not to be accidentally misplaced when turning the screw heads.

With the hands upon the triangle and the eye at the microscope tube, the razor can be moved so that its edge shall either make a drawing cut or push straight through the object like a chisel, ac-

Fig. 42.

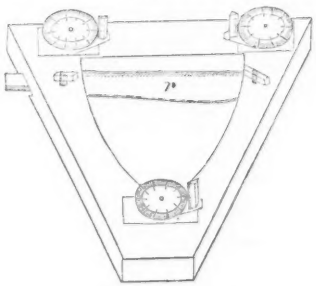
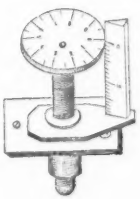


Fig. 43.



cording as either method or any gradation between them suits best the nature of the substance cut. Thus perfectly even slices can be cut, and it is quite easy to take them in consecutive order even when called off in the midst of the work and compelled to wait half an hour before resuming it. It is a luxury to take off slice after slice and know that there is no danger of losing just the slices you want especially to see. The object is kept wet with glycerine, and just as the razor begins to cut, a drop of glycerine is placed on its edge in which the slice floats without sticking; though care must be taken in the case of very thin and small sections not to lose them in a large drop of glycerine in which they would be found with great difficulty. By this method slices $\frac{1}{8000}$ of an inch in thickness, or rather in thinness, can be all worked out nicely, though before it was adopted such thin slices were all

torn, so as to be unrecognizable. Whether a blade can be made to cut any thinner than that has not been tried; but it may be remarked that the first razor blade used gave out at $\frac{1}{24000}$ inch thick, and would not take an edge capable of cutting finer than that."

## NOTES.

After twenty-seven years of unremitting toil for the advancement, the exaltation and free spread of science in this country, the land of his adoption, Louis Agassiz died, in the ripeness of his years, Dec. 14, aged sixty-six. It is not the time now to estimate Professor Agassiz's scientific attainments and compare him with his contemporaries, but to mourn the loss of one whose profound learning and genius for original research; whose organizing abilities, courageous adherence to the dictates of his conscience when matters of scientific faith were at stake; whose persuasive eloquence, rare personal magnetism, conspicuous enthusiasm, and untiring industry which, though it shortened his life, intensified its value, made him one of the remarkable men of the century.

A student and friend of Humboldt and Cuvier, and enjoying the instructions of Oken, Tiedemann and others, he certainly had wonderful advantages, and by his native genius and sturdy industry made the most of them, his reputation being more than European before he was thirty years of age. At the age of thirty-nine he came to this country, travelled extensively, and extended his glacial theory to include both hemispheres. Here he began to build up the Museum of Comparative Zoology, his singleness of purpose, rare personal qualities and disinterested zeal, winning him friends and means for carrying on that vast establishment. Meanwhile he travelled and lectured over the country; everywhere by his native unaffected eloquence winning men to a just appreciation of the objects and needs of science, and elevating and dignifying the pursuit of knowledge for its own sake. He was an admirable teacher, and introduced new methods of studying zoology. He gathered about him a number of young men, some of whom were associated with him in the preparation of the material for his great work, "Contributions to the Natural History of the United States;" and so powerful was his influence over his students that he may be said to have founded a school in natural history, based on the spirit of Cuvier, who moulded Agassiz himself in his student days.

Then came his Brazilian journey, with the immense zoological treasures accruing. Hardly resting from this exploration he organized the Hassler Expedition around the continent of South America, under the auspices of the Coast Survey, and recuperated his shattered health on that long voyage. Finally, he established, with the aid of its liberal founder, the Anderson School of Natural History, and it was there in his disinterested labors in behalf of improved methods of teaching in our higher and normal schools that he undoubtedly overworked himself and lost the strength to resist the strain of duties and cares that multiplied during the succeeding autumn.

He died literally in the harness; full of plans for the development of his great museum, for the enlargement and full success of the Anderson School at Penekese Island, meanwhile doing original work at the museum, writing a course of articles for the "Atlantic Monthly," and preparing some papers for this journal; all this, while performing his college duties in the lecture rooms and laboratories of the museum, with a course of popular lectures at Washington on his hands, and meanwhile not unmindful of the calls of social life.

Professor Agassiz was perhaps the most widely known and popular man in the United States. In his death it may be said that science has lost one of its most gifted followers, and humanity, in his long devotion to all that tends to elevate the race, one of its best types.

It will be seen by the following letter, dated San Francisco, Cal., Dec. 2, 1873, from Mr. W. H. Dall, that the explorations of which he has charge have been quite successful:—

"We have had a very successful season, though the spring was a very late one, and have accomplished more than I dared to hope at first. Our work lay in the islands between Attu and the Shumagins. We have visited nearly every point of interest in the Aleutian chain, including Attu, Kyska, Amchitka, Adakh, Atka, Four Craters, Bogosloff, Unalashka and the Shumagins, correcting the astronomical positions, variation of the compass, general hydrography, etc. We surveyed a harbor for the landing of one end of the Japan cable—if they take it that way—on the island of Kyska. We made some interesting soundings in Behring Sea, showing great depths of water in the western part of it, with a bottom of Globigerina ooze, our deepest cast giving about 1200 fathoms without bottom. We disproved the existence of the cel-

ebrated Bogosloff reef, finding 800 fathoms without bottom where it is laid down on the chart. We found the magnetic variation to be less easterly than when the last observations were taken. During our leisure natural history was not neglected, and we now have a magnificent geographical collection, especially in marine invertebrates. In birds, too, we did very well, and especially in prehistoric relics. We found no Asiatic influence in the western islands but a more predominating Arctic type of fauna and flora as we went west. We got several hundred wood carvings from caves, about three hundred bone and stone implements and thirty-six prehistoric crania and some later ones.

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